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DEVELOPMENT OF AN INTEGRATED SYSTEM FOR EVALUATION OF OREGON'S TRUCK DATA. PHASE 2-EVALUATION OF DATA

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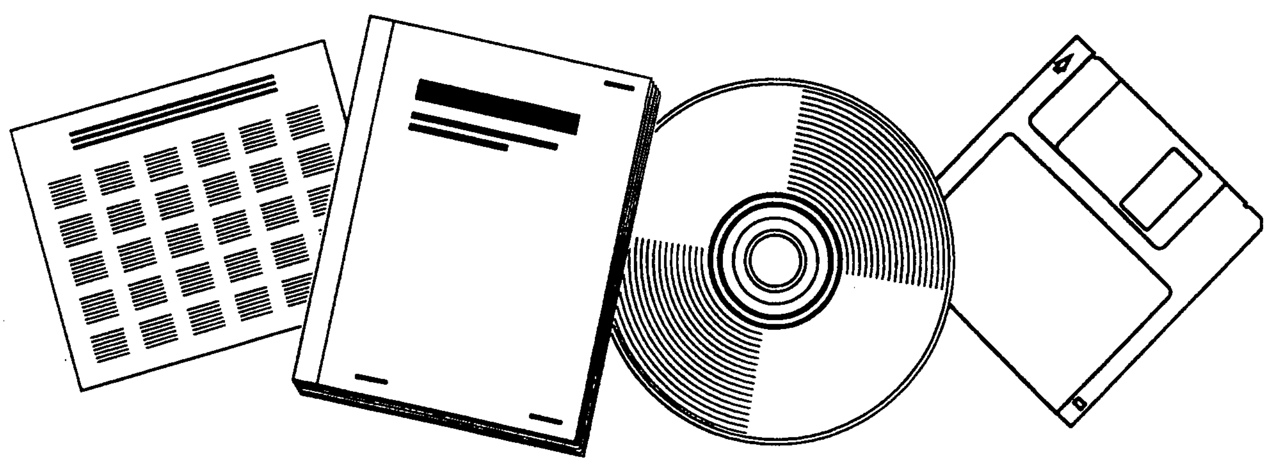

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Final Report
TNW 97-16

DEVELOPMENT OF AN INTEGRATED SYSTEM FOR EVALUATION OF OREGON'S TRUCK DATA

Phase 2-Evaluation of Data

by

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16. Abstract

Oregon DOT's Permits and Weighmaster section has been increasing the automation of its data collection procedures for many years Recently, this has included developing computerized records for all the routinely collected data at the six Ports of Entry (POEs). Data for every truck passing through the POEs has been recorded since 1989. In addition, Oregon has 95 other weigh sites, many of which are only open occasionally, but nevertheless annually produce considerable data concerning trucks. ODOT has introduced computerized record keeping for these weigh sites more recently. Effective use of truck data stored in computer databases requires ease of accessibility and data analysis in a form that is easily understood by users not familiar with the database system. This report describes the design of user interfaces for the database. The interface will allow users to interact with the system effectively. Various reports summarizing general truck data and citation information can be generated. A second objective of this report is to demonstrated new and effective use of the data. Particular emphasis is on commodity data. Commodity movements can only be tracked on a limited basis because of the way such data is recorded. A new commodity coding scheme is described; its use shows significant enhancement in the quality of data analysis.

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DISCLAIMER

The contents of this report reflect the views of the authors, who are solely responsible for the facts and accuracy of the data presented. The contents do not necessarily reflect the official view or policies of TransNow or the Oregon Department of Transportation (ODOT). The results reported here are not necessarily in agreement with the results of other TransNow or ODOT research activities. They are reported to stimulate review and discussion within the transportation community. This report does not constitute a standard, specification, or regulation.

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1.0 INTRODUCTION

1.1 Background

In 1988, the Oregon Department of Transportation's Permits and Weighmasters unit embarked on a program to automate weighing procedures and computerize data collection. This program, which continues to grow, includes weigh-in-motion (WIM) sorters at Oregon's busiest weigh sites and permanently-installed computers used for data collection at about 30% of the state's weigh sites. The program has saved money for the weighmasters and the Public Utilities Commission (PUC), the two main agencies responsible for enforcing Oregon's truck laws, by making it easier for them to identify offenders and to direct enforcement efforts. At the same time, the program has saved money for truckers by reducing the time they spend waiting to be weighed.

Although the automation program is meeting the weighmasters' original goals, the potential exists within the Oregon Department of Transportation (ODOT) to expand this program for use by other units. For example, ODOT could use the axle weight data for pavement design and the commodity data for strategic planning. Oregon's 101 weigh sites routinely collect this data, as well as a variety of other potentially useful truck information. The state's six ports of entry alone have collected more than 4 million weighing records since 1989. These records are stored in truck databases shared by ODOT and the PUC. Three tables within these databases have the greatest potential for use outside the Weighmasters unit: static scale vehicle statistics, WIM weighing records, and citation records.

Three obstacles have prevented other ODOT units from routinely using this truck data until now. First, no interface program had been developed for the three database tables. This meant that a unit that wished to use the data needed to have a database expert who understood how the databases were arranged and what the different codes meant, and who could write special programs to use the data. Second, the data are not stored in a single location, but are scattered among the PUC, the weighmasters' main office in Salem, and the weighmasters' district offices. Finally, the coding method used for certain data have greatly reduced their usefulness for many planning and design applications.

These obstacles have forced ODOT units that require truck data to ask the weighmasters to conduct special surveys, which has detracted from the weighmasters' primary duty of enforcing Oregon's truck size and weight laws. For example, the Strategic Planning unit could not access easily the wood products commodity data that had already been collected. Instead, the unit had to ask the weighmasters in each district to estimate the volume of wood products passing through each weigh site. As another example, the Department of Motor Vehicles has asked the weighmasters to fill out a special form whenever a truck carrying farm products passes through a weigh site. In this case, the extra work is required partly because agricultural commodity data are not routinely collected.

1.2 Study Plan

Phase one of this study, conducted during 1992–93, consisted of developing a user interface for the static scale and citation databases and demonstrating new uses for the data (Bell, et al., 1993). The interface allows ODOT units to access the data, print out summary reports for frequently-requested information, and save data in a form that can be imported into a spreadsheet. Since the weighmasters' database software does not have a graphics capability, programs were also developed for several spreadsheet packages used within ODOT. These programs allow users with minimal knowledge about a particular spreadsheet to import data and display graphs.

The second phase of this study, conducted during 1993-94, concentrated on one area of particular importance, commodity data, to improve the way the data are coded and demonstrate ways they can be used. Also during this time, the user interface was fine-tuned, user manuals written, and training conducted within ODOT, demonstrating how various units could use the new interface.

This study only addressed the vehicle statistic and citation tables, although a database format also exists for WIM weighing records. Due to the volume of data collected, the WIM data presently are collected and processed on site. Only summaries of the data are sent to Salem. In addition, the data from the older WIM systems are not nearly as accurate as those from newer systems. However, since it is expected that WIM technology will improve and become more widely used in the future, the new data coding systems developed during this project are designed to be compatible with the coding systems used by WIM. Further description of Oregon's WIM efforts can be found in Mohensi (1985), Bell and Mohensi (1986), and Bell and Krukar (1987).

1.3 Organization

Chapters 2 and 3 of this report describe where and how truck data is collected and how the data are stored within the databases. Chapters 4 and 5 demonstrate how the data can be used for pavement design and strategic planning applications. Finally, Chapter 6 presents conclusions and recommendations.

Several Appendices are included for software documentation and detailed data analyses.

2.0 WEIGH SITE DATA COLLECTION

Truck weigh data are collected at a number of sites throughout Oregon. The proportion of trucks that are weighed, the kinds of trucks that are weighed, and the data that are collected vary greatly from site to site. In order to obtain meaningful results from an analysis of a particular site's data, the data collection methods must be clearly understood.

Trucks can be weighed by one of three means. Automated weigh-in-motion (WIM) scales are used for data collection along Oregon's busier highways and as sorters at the busiest weigh sites. The locations of the WIM sites are shown in Figure 2.1 (the Lowell site will be installed during 1994). Permanent static scales are located at Oregon's six ports of entry (POEs) and at many of the state's 95 other state-owned sites; the state also occasionally operates some county-owned scales. Portable scales are used at the remaining state-owned sites and at undeveloped locations. Figure 2.2 shows the locations of all state-owned weigh sites.

2.1 Weighing Records

Weighing records have traditionally been recorded on paper. Paper records include a truck's license plate number, carrier name, weighing time, direction of travel, vehicle type, number of axles, commodity, and gross weight. These records are sent to the PUC in Salem, where the data are manually transcribed into computer records. Because of backlogs, it can take several months before an electronic version of a paper weighing record is generated.

Part of the weighmasters' automation effort has been to install computers at the busier weigh sites in each district. The computers make it possible to record more data in the same amount of time, eliminate the need to copy data from paper to an electronic format, and make the data immediately accessible, all of which result in cost savings for the state. Because truck

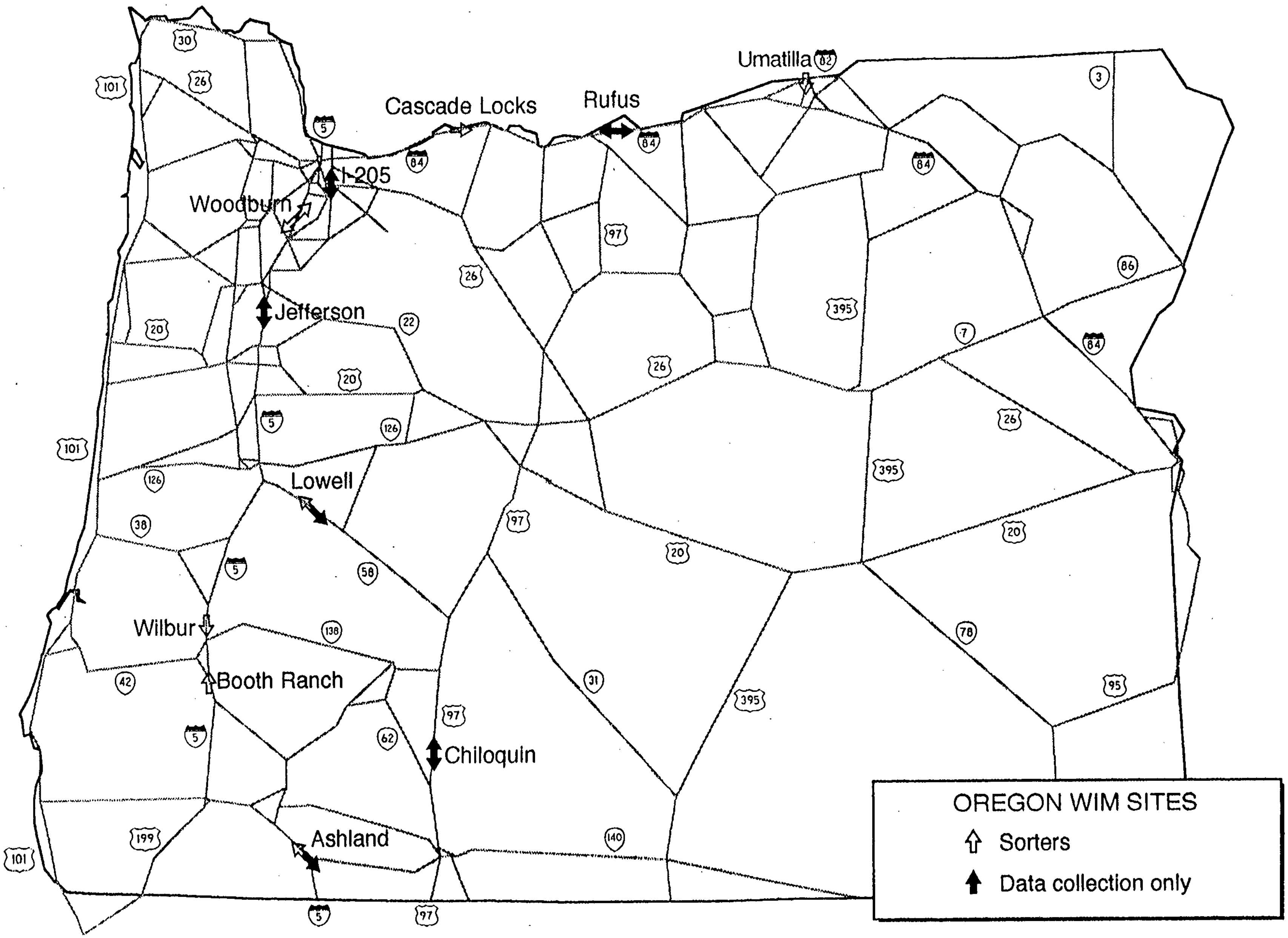

Figure 2.1. Oregon Weigh-in-Motion Sites

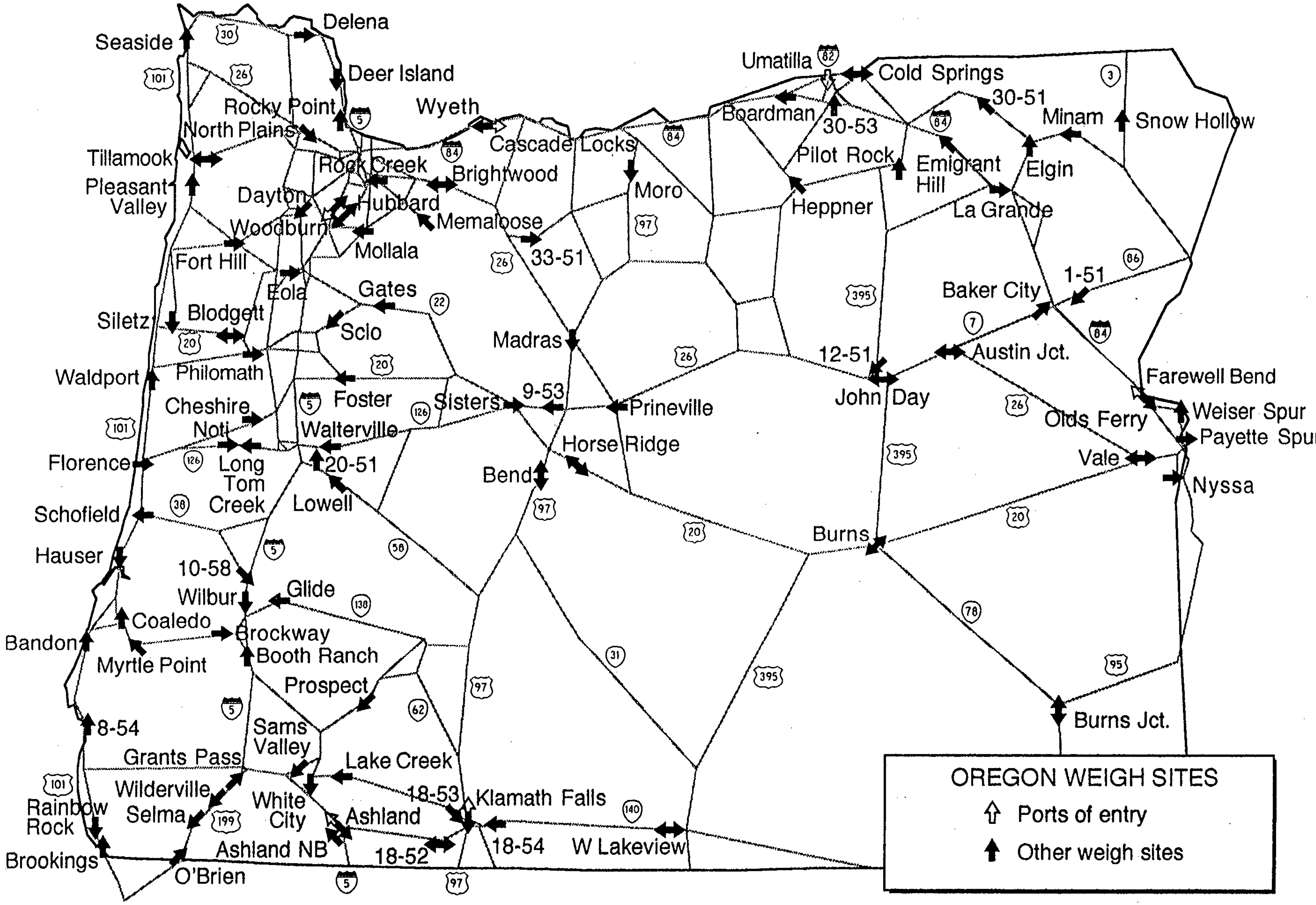

Figure 2.2. Oregon Weigh Sites

registration records are also stored on the computers and can be updated at the start of each day (or as frequently as every three hours at the POEs), the weighmasters can identify immediately trucks that are not registered with the PUC, as well as "chronic offender" trucks — trucks that are cited much more frequently than average. Computer records include the weight of each axle group, in addition to all of the information recorded on paper records. The sites with installed computers are shown in Figure 2.3.

At the non-POE computerized sites, data are still recorded on paper during the first 10–15 minutes after opening (when updated registration records are being copied to the computer) and the last 10 minutes before closing (when the weighing records are copied to tape). These records are later copied onto a hard disk at the district office. When the disk approaches capacity, the district office sends the data by modem to the weighmasters' Salem office, where they are archived on tape. However, if the need exists, the Salem office can call up a district office's computer at any time to download weighing records.

Data can also be recorded electronically at the sites where no computer is installed. Each district owns several portable computers which, at the district's option, may be taken to low-volume sites to record weights. Here, a tradeoff is involved between the amount of time a weighmaster is able to spend during a shift actually weighing trucks (since some time is required to load and unload the data) versus the convenience to others of having an electronic version of the weighing record.

2.2 Weigh Site Hours of Operation

The hours that weigh sites are operated range from 24 hours a day at the six POEs and the automated WIM sites to a few hours a month (or even not at all) at some rural, low-volume

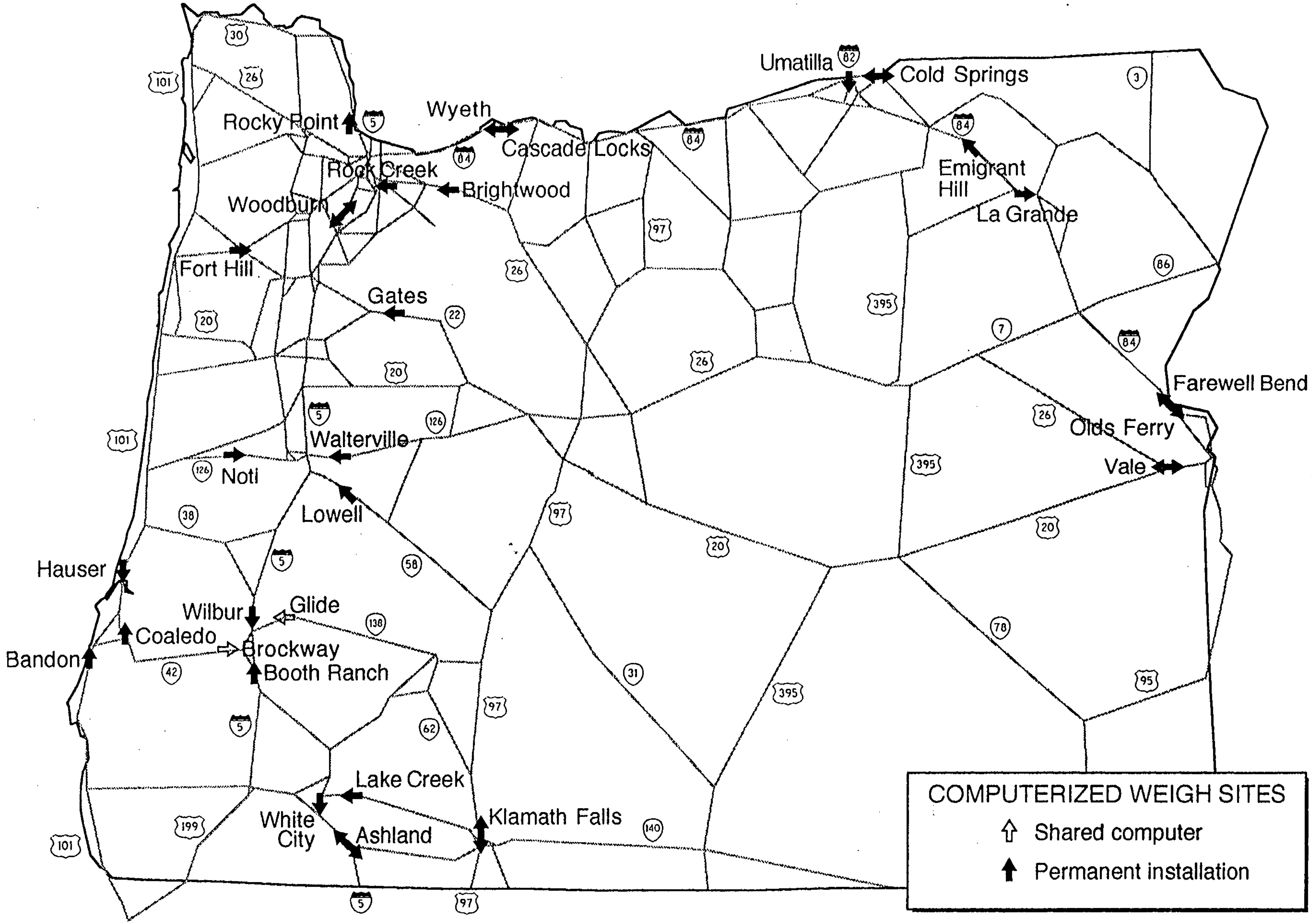

Figure 2.3. Computerized Weigh Sites in Oregon

sites. Generally, the higher the truck volume at a site, the more often it will be open. A scale can be operated at any time of the day or night, on weekdays or weekends. When opened, a scale might be in operation for only a couple of hours, roughly six hours (typical), or continuously for a period of 24–72 hours.

2.3 Truck Sorting

A scale will not weigh every truck passing by while it is open. The busiest scales have WIM sorters that are designed to send only the heaviest trucks or those with overweight axles to the static scale. These sorters save time for truckers because many (up to 80% in some cases) are able to bypass the scales altogether, while those who are diverted to the static scales spend less time waiting in line to be weighed. All WIM sites include height detectors and automatic vehicle identification (AVI) equipment that collect information from transponder-equipped trucks. Less-busy scales have bypass lanes which allow empty trucks to avoid the static scale. During busy periods, trucks may be "waved past" the scale if the truck queue backs onto the highway; trucks will also be waved past a rural scale if a truck inspection is being conducted. At rural sites that are manned by only one weighmaster, trucks are usually not weighed while a citation is being written to another truck. Finally, some trucks deliberately avoid scales to avoid being cited for overweight conditions, even though the weighmasters periodically use portable scales on back roads to catch these offenders.

Three weigh sites, Booth Ranch and Wilbur on I-5 and Umatilla on I-82, have sorters in the right-hand freeway lane which weigh trucks at freeway speeds. Electronic signs tell trucks that are heavy or possibly overweight to exit to the weigh site, while the remaining trucks are allowed to stay on the freeway. (Some drivers who are not familiar with the sorter system play it safe by exiting to the scale even when they are not directed to.) A video camera captures pictures of the trucks that are sorted to the static scale, making it easy for the weighmaster to spot any trucks that try to avoid the static scale. This sorter system improves safety by reducing conflicts from trucks reentering the freeway and saves time and money for empty trucks by not forcing them to slow down while using a bypass lane within the weigh site. Static weighing records are generated for only the heaviest trucks on the highway at these sites; most other trucks never have static scale records generated for them (a WIM weighing record is generated for every truck, though). These sorter systems can be fooled by short axle spacings on log and other trucks, sending them to the static scale even when no overweight condition exists.

Four other weigh sites, Ashland and the two Woodburn sites on I-5 and Cascade Locks on I-84, have sorters within the weigh site. All trucks exit to the scale and are weighed by WIM at about 35 mph (56 km/h). Signals indicate whether a truck should proceed to the static scale or should use the bypass lane. As before, WIM records are generated for all trucks and static records are generated for the heaviest trucks. However, static records can be generated for trucks using the bypass lane as long as another truck isn't being weighed; these partial records will contain the truck's license number and truck type, and "0" for commodity, number of axles, and axle and gross weights.

Most scales are not equipped with sorters. At these scales, static records are generated for loaded trucks and partial records are generated for empty trucks in the bypass lane as long as another truck isn't being weighed. Table 2.1 summarizes the data available from each kind of weigh site.

Table 2.1. Data Available from Oregon's Weigh Sites

Weigh Site Type	Operating Frequency	Data Format	Trucks Weighed	Information Recorded: Axle Weights	Information Recorded: Commodity
WIM	continuous	electronic	all	Y	N
Port of Entry	continuous	electronic	K. Falls, F. Bend: non-empty[1] Umatilla: heavy/overweight only others: heavy/overweight[1]	Y	Y
Sorter	frequent	electronic[2]	Sorter... on mainline: heavy/overweight only inside weigh site: heavy/overweight[1]	Y[2]	Y
Computer only	occasional	electronic[3]	non-empty[1]	Y[3]	Y
No sorter or computer	seldom-occasional	paper	non-empty[1]	N	Y

Notes: (1) Empties recorded when not busy
(2) Wilbur, Booth Ranch, Lowell (when installed): except at the start and end of the shift
(3) Except at the start and end of the shift

3.0 OREGON'S TRUCK DATABASES

The Oregon Department of Transportation and the PUC maintain several truck-related databases. As mentioned previously, the data are not stored all in one place. In the case of the WIM records, the data are kept and processed on site. The database maintained by the Weighmasters unit contains a total of 48 tables, as follows:

1,2.	Plate01–Plate02	23.	Shared_memory
3–10.	Name01–Name08	24.	Exec_authorization
11.	Statistic	25.	Config_rec
12.	Wim_stat	26.	Profiles
13.	Stat_modification	27.	Batch-tracking
14.	Cite_tracking	28.	Host_batch_trk
15.	Cite_modification	29.	Host_batch_no
16.	Mon_triples	30.	Extract_tracking
17.	Mon_opr_summary	31.	Portable_activity
18.	Mon_productivity	32.	Cres_batch_no
19.	Temp_productivity	33.	Crescent_tracking
20.	Dly_opr_summary	34.	Citation
21.	PUC_wgt_rep	35.	Cite_summary
22.	Appl_parameters	36–48.	Cite_pk1–Cite_pk13

The two tables of interest to ODOT units outside the Weighmasters unit are the "Statistic" table, which contains static scale weighing records, and the "Citation" table, which contains citation records generated by the weighmasters. During phase 1 of this project, another table, "WSClass," was created for use by the database interface program. The new table matches highway characteristics (Interstate, National Highway System, Access Oregon, state primary, state secondary, and county) and scale characteristics (name, abbreviation, and a port of entry flag) to the scale identification numbers used in other tables. The structure of the new table, as well as a description of the prototype database interface was given by Bell, et al. (1993).

3.1 Vehicle Statistic Data

The vehicle statistic table contains the following static scale data for records generated on computer:

- Oregon license plate number.
- Vehicle owner (first 5 letters of the name).
- Weigh site ID number.
- Time and date of weighing (time code in seconds; time and date in 24-hour and yymmdd formats).
- Vehicle type (Table 4.1).
- Number of axles.
- Commodity (Table 5.1).
- Gross weight, in hundreds of pounds
- Whether a warning was issued and why (6TA= 600 lb overweight on a tandem axle).
- The reason a WIM sorter, if present, diverted the truck.
- The weights of up to 12 axle groups, in hundreds of pounds.

- The badge number of the weighmaster who weighed the vehicle.
- The CPU processing time.

The weighmaster types in the license plate number, the vehicle type, the number of axles, the commodity, and (optionally) the axle group weights. The remaining items are filled in by the computer from registration records, calculations, and data from the scale mechanism, as well as from data entered into the computer when the weighmaster started his or her shift.

Records obtained from the PUC that have been generated from paper weighing records do not include axle group weights, WIM sorter information, or CPU processing time.

3.2 Citation Data

Copies of all truck citations issued in the state of Oregon are sent to the PUC, where they generate citation records in the PUC/ODOT database. Truck citations include size and weight citations, which are usually issued by state or county weighmasters, and truck safety citations, which are the result of truck inspections conducted by state weighmasters, PUC inspectors, state patrol officers, and inspectors from three sheriff's departments and two city police departments (Oregon PUC, 1992).

Citation records maintained by the weighmasters include the following information generated by weighmaster-issued citations:

- Oregon license plate number.
- Weigh site ID number.
- Time and date the citation was issued (time code in seconds; time and date in 24-hour and yymmdd formats).
- Citation number.

- Driver license information, including address, height, weight, sex, race, eye color, hair color, birth date, license number, phone number, and endorsements (not all states include all of this information on their licenses).
- A flag indicating whether the driver is an independent or works for a company
- Vehicle information, including year, make, model, and style.
- State vehicle is registered in.
- Truck company or independent operator's name and address.
- Flags for the kind of violation (crime vs. infraction; single, tandem, consecutive axle group, vehicle [tractor or trailer], or combination [tractor and trailer] overload; width, height, or length violation; truck safety violations [driver vs. equipment]; permit violation; not registered with the PUC).
- Allowed size or weight and measured size or weight (if applicable).
- Written description of the violation.
- A 12-letter description of the commodity.
- The 4-digit hazardous material ID code (if applicable).
- The time and date for the arraignment.
- The bail amount.
- The badge number of the weighmaster who weighed the vehicle.

3.3 Weigh-in-Motion and Automatic Vehicle Identification Data

The automated sorter and data collection systems collect the following information, which are stored on site (Bell and Krukar, 1987):

- Time and data of weighing.
- License plate (if the truck is equipped with a transponder).
- Vehicle length.
- Number of axles.
- Axle spacing.
- Individual axle weights.

The on-site computer processes this information and generates other data, including a vehicle classification code (Table 4.2).

3.4 ODOT Database

The ODOT database in Salem uses Informix software (1). Informix is a relational database management system (DBMS). It includes application development tools and software. The two Informix products used in this research are INFORMIX-SQL and INFORMIX-SE.

INFORMIX-SQL is a computer-based record keeping system. Similar to other structured query languages, INFORMIX-SQL is a high level language that is used to direct all operations on the database. As a database management system, INFORMIX-SQL consists of useful programs or modules that perform data management tasks. Once developed, INFORMIX-SQL applications can be executed with a database engine or server that manages the database and interprets the SQL. INFORMIX-SE is one of the Informix database engines.

3.5 Interface Design

A design for DBMS requires many decisions, including where to store data, how to access data, and how to format data for display as a report or a form. A prototype database system was developed which is consistent with the existing database at ODOT in Salem. This system consists of a database management system, together with spreadsheet software and statistical package design to allow users to generate reports and perform statistical analysis. As shown in Figure 3.1, the model consists of three major subdivision or functional areas: the DBMS itself, spreadsheet and statistical analysis, and post-processor. Each is capable of operating independently of others and communicates with others through files and/or database.

The DBMS was developed by use of INFORMIX-SE and INFORMIX-SQL. The DBMS was designed to control the data resources to ensure minimum storage and fast data processing time, and provide the ability for end-users to directly access data. It facilitates user-friendly data entry, data query, report generation and statistical analysis on the collected data. It compiles a report specification into a program that can be executed when desired. Also, the built-in system utilities allow users to load and unload ASCII data or worksheet file into or out of the database for statistical analysis.

Based on the outputs from the DBMS, the spreadsheet and statistical components may work interactively and/or independently of the other components and communicate with them through files and/or database. The post-processor will import and translate outputs into user understandable forms and display meaningful graphs.

There is a major difference between the post-processor and the other sub-systems. The DBMS requires access to the database and will operate in Informix. However, the post-processor only needs to interface with the DBMS outputs, which are sequential ASCII files, and

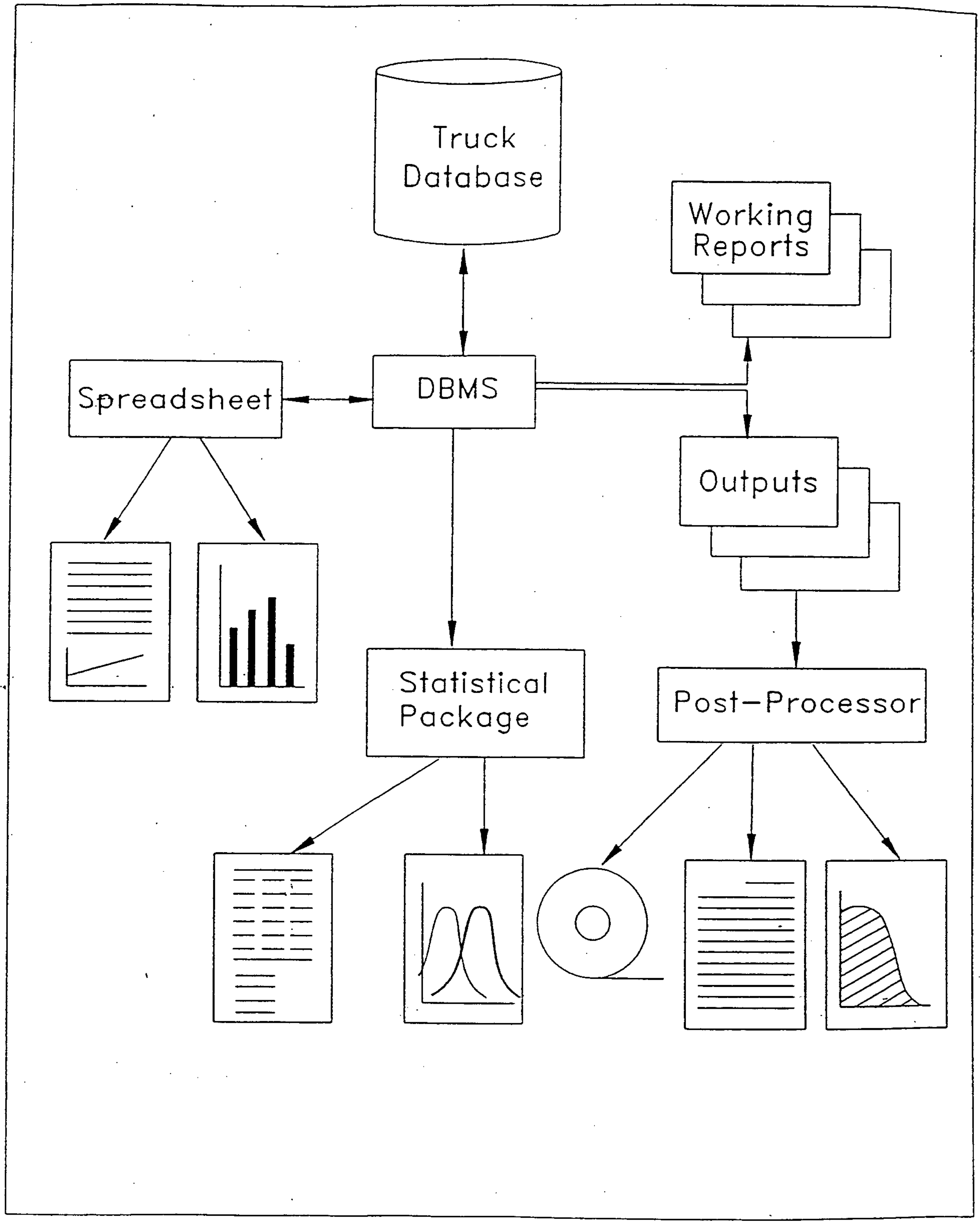

Figure 3.1. Overview of the Representation Model

is therefore more loosely coupled with the rest of the system. The post-processor can therefore be implemented on a graphics-oriented microcomputer as a special output display.

3.6 Database Schema Design

As mentioned earlier, there are a total of 48 tables in the ODOT database, but only two of them, the "statistic" table and the "citation" table, were used in this research. The "statistic" table contains vehicle weight information; the "citation" table holds citation-related information such as driver's records, vehicle information, violation descriptions, and vehicle owner's information. All the reports in this research are primarily derived and generated from these two tables. Additionally, two new tables, "wsclass" (Weight_Station_Class) and "hazmatl" (Hazardous_Material), were created. The "wsclass" table defines different highway classification information for each weigh station; the "hazmatl" table contains the old and revised commodity coding systems used in the ODOT database. These two tables and their relationship with the "static" and the "citation" tables are described in Figure 3.2.

As can be seen from the database schema design in Figure 3.2, a single common field (or key field) is used to relate tables. The field "w_st_id" (weigh station id) in the table "wsclass" is used to link to the field "c_station" in the table "citation" and the field "s_station" in the table "statistic" while the field "h_id_code" in the table "hazmatl" is linked to the field "c_comm_code" in the table "citation" and the field "s_commodity" in the table "statistic". Note that the common field has been given the exact same Field Type in the structure of all the related tables. This is essential to the success of relational database design. Notice also that the type of the fields "w_st_id" and "h_id"code" is marked with an asterisk, indicating that it is the

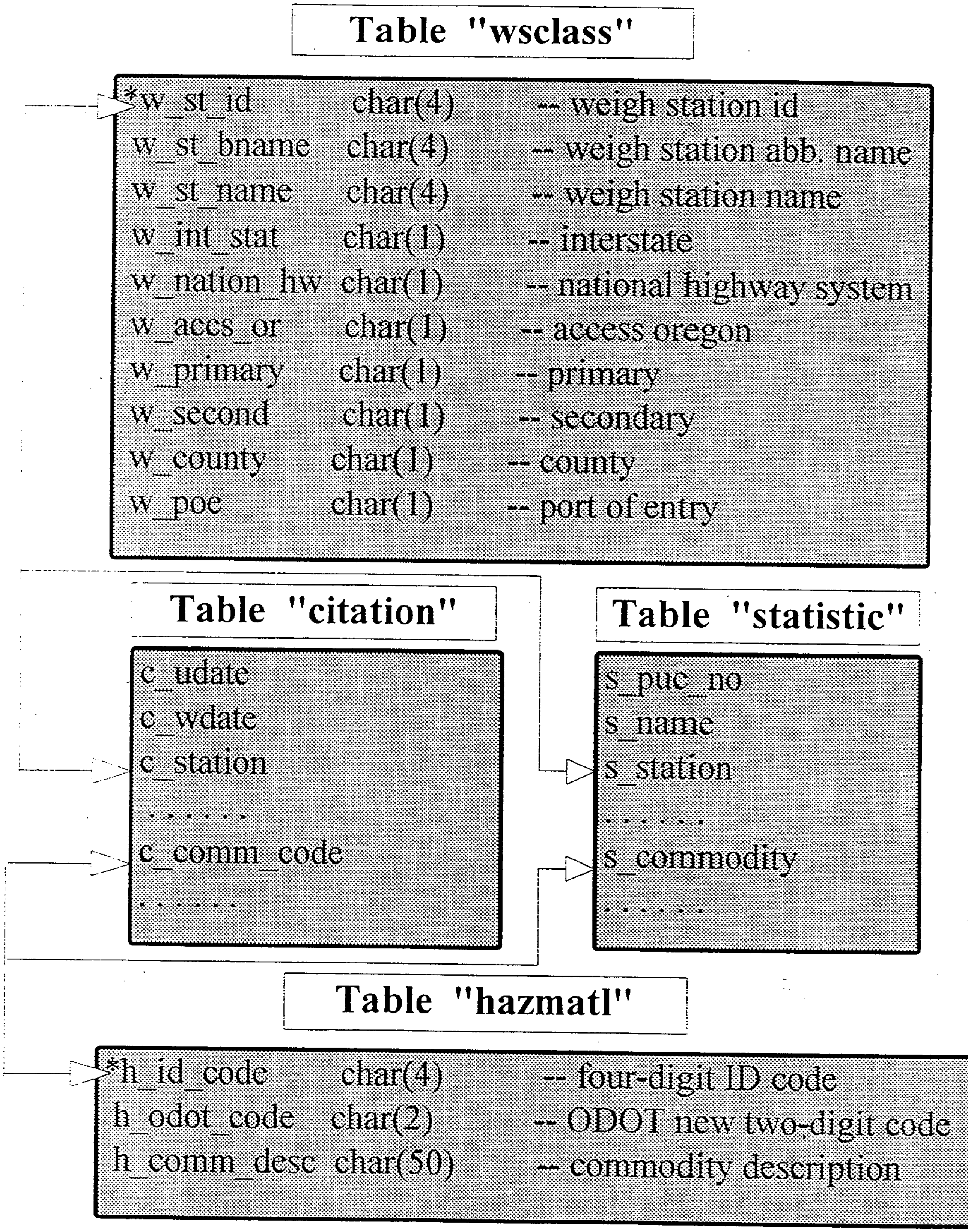

Figure 3.2. Database Schema Design Outline

key field. Informix uses these fields when sorting tables and when rejecting duplicate entries. Dividing the information into separate tables minimizes the redundant data.

The two new tables can also be used as look-up tables when generating reports and editing/querying data. Since mixed commodity codes are currently used by the ODOT, the table "hazmatl" was designed not to conflict with the existing 0-9 coding system, nor with the hazardous materials codes stored in the existing database. These two tables can be easily implemented into the current ODOT database and no change is needed to the existing table structures in the database. The seasonal, annual, and directional commodity flows can be determined by using the relationships among these four tables.

3.7 Database Applications

Two application softwares were developed in this research: the database management system (DBMS) and the graphical software (GRAPHER). The DBMS is a relational database management system which performs data manipulation and generates working reports based on user requirements, while the GRAPHER is a graphical application software specifically designed for post-processing of the DBMS.

The database management system is menu-driven and a typical user may not be familiar with Informix software or database concepts. The system provides all necessary information to execute an application, such as generating a working report, data entry/query. It compiles report specifications into programs that users can run whenever they want to run a report. All report files are saved in an ASCII data file. A sample report file is shown in Figure 3.3; additional sample reports are shown in Appendices C, D, and E. For details on the use of the DBMS, refer to Appendix A.

CITATION SUMMARY

from: 02-01-93 to: 03-01-93

Report run date: Aug 18, 1993

		OVERWEIGHT					TRK	NON	OVER	NO
SITE	NAME	AX	TA	GA	VEH	COM	SFTY	WT	SIZE	PUC
0307	BRIGHWD WB		2	1						
0308	BRIGHWD EB	2	5						1	1
1404	CCL POE	12	85	55	2	23	9	10	8	
1502	WHTE CITY	1	1	2		1				
1504	ASLND NB	1	2	1			1	1		1
1506	ASLND SB		7				2			3
1507	ASLND POE	10	75	39		8	2	2	7	
1509	LAKE CRK	1	5	7		4	5			
1701	GRNT PASS		3			1				
2304	BALE		9	6		4			2	20
2305	OLDS FERRY	3	14	15	1	2		1	1	14
2306	F.B. POE	3	48	22		10	10	1	9	
2307	BURNS JCT			1		2				4
2402	HUBBD SB	3	4	4		1	1	2		
2407	HUBBD NB	1	3	3			1			
2408	WDBRN NB	5	39	15	1	5	2	4	4	2
2409	WDBRN POE	32	133	49	1	17	7	21	10	1
2903	TILLAMOOK		4	8						
3602	DAYTON		2	3		2			1	1

AX - single axle overload
TA - tandem axle overload
GA - group overload
VEH - vehicle overload
COM - combination overload
TRK_SFTY - truck safety
NON_WT - non-weight violation
OVERSIZE - vehicle size violation
NO_PUC - not registered with PUC

Figure 3.3. Citation Summary Report (February 1993)

The GRAPHER is developed using Quattro Pro macro programming and is mainly designed for spreadsheet novices, but it can also be used by all users wishing to quickly achieve maximum productivity with the program. The GRAPHER interacts with the windows environment and generates reports and graphs. When loaded, the program imports a working report file into a notebook window, converting it to a designed format and generating meaningful graphs in the process. Users can edit, view, print a report and/or graph. The user's guide in Appendix B provides users with a comprehensive tour of the program.

Both the DBMS and the GRAPHER are developed for IBM-PCs or compatible systems. The DBMS, however, can be readily transported to the UNIX operating systems. This compatibility allows the ODOT database administration staff to easily implement the DBMS into the existing ODOT database system in the UNIX environment and keep the current database intact. The GRAPHER is designed to run with Microsoft Windows. It can be implemented on a graphics-oriented microcomputer as a graphical application.

4.0 APPLICATIONS

4.1 Pavement Design Applications

The pavement design procedure developed by AASHTO uses the concept of "equivalent standard axle loads" (ESAL) to determine the pavement damage potential of different combinations of axle groups and axle weights (AASHTO, 1986). If the number of axles in an axle group and the axle group's weight are known, the design procedure can compute an ESAL for that group. An 18,000-lb (80-kN) single axle as an ESAL of 1.00; an axle group with an ESAL of 2.00 is twice as damaging, while an axle group with an ESAL of 0.50 is half as damaging.

ODOT's current design procedure uses the concept of "damage factors" to produce an estimate of the cumulative number of ESALs that are applied to a particular section of road during a year. A damage factor multiplied by the average daily traffic along a stretch of road estimates the total number of ESALs that will be applied to that stretch of road during a year. Oregon's damage factors were developed from weighing records supplied by the state's weigh-masters some years ago. The same factors are used for all pavement design projects in the state. ODOT's system takes advantage of the fact that traffic counts have been easier to obtain in the past than truck weight information.

One way to use the static weigh data is to update the existing damage factors. If it is found that some truck types are more (or less) heavily-loaded than the present factors indicate, the factors can be adjusted appropriately. However, the factors would still only provide an estimate of the annual number of ESALs, albeit a more accurate estimate.

Another way to use the data is to calculate an exact ESAL for every truck that is weighed. ESALs calculated by the damage factor method are based on average Oregon trucks and may not be representative of the trucks using a particular road. Calculating exact ESALs would allow pavement design to be tailored to the trucks using a road, which could help avoid premature pavement failure due to inadequate pavement thickness, or the opposite, a pavement that is thicker (and more expensive) than necessary.

To calculate an ESAL, the number of axles in each axle group must be known; however, this information is not recorded. When a truck is weighed, only the axle group weights, the number of axles, and a code (0–8) indicating the general truck type are recorded. The truck type is based on trailer configuration (Table 4.1) and provides no help in determining the axle configuration. The WIM systems, on the other hand, classify trucks into 19 categories, most of which provide exact axle configurations (Table 4.2). Fortunately, the WIM truck type codes can be calculated from the data provided in the vehicle statistics records generated at the static scales.

Table 4.1. Static Scale Truck Type Codes

Code	Truck Type
0	Tractor only or empty
1	Single-unit
2	Tractor and pole trailer
3	Tractor and semitrailer
4	Tractor and trailer
5	Semitrailer/trailer or two trailers
6	Triple trailer
7	Dromedary truck and semitrailer
8	Other

Table 4.2. WIM Truck Type Codes

Code	Truck Type
1	Passenger cars, vans, pickups
2	Light vehicles with trailers
3	2-axle single units
4	2-axle buses
5	3-axle single units
6	3-axle combinations
7	3-axle buses
8	4-axle combinations (2–S2, 2–2)
9	4-axle combinations (3–S1)
10	4-axle single units
11	5-axle semis
12	5-axle twins
13	Other 5-axle combinations (3–S1–2)
14	Other 5-axle combinations (2–2–2, 2–S1–3)
15	6-axle combinations
16	Triples (2–S1–2–2)
17	7-axle combinations
18	8-axle combinations
19	9-axle combinations

A computer can apply a few simple rules to determine a WIM-type vehicle code from a static scale weighing record. The process is simplified by the fact that the first axle, the steering axle, is always a single axle. The following rules identify 85% of all loaded trucks on Oregon's Interstate highways; similar, but slightly more complicated rules can be applied to determine the remainder:

- If there are two axle groups, the truck is a single unit. The number of axles in the rear group equals the total number of axles minus one.
- If the number of axles is the same as the number of axle groups, all of the axle groups consist of single axles.
- If the number of axles is one more than the number of axle groups, one of the axles is a tandem and the rest are singles. Unless a weight violation occurred, the heaviest axle group should be the tandem.
- If there are three axle groups and five axles, the choices are single-tandem-tandem (the typical "eighteen-wheeler") or single-single-tridem. The relative axle group weights will determine the proper classification.

Because empty trucks using the bypass lane are recorded using zeroes for all of the axle group weights, these trucks cannot be classified using this method. Since these trucks are empty, though, their cumulative ESALs will be very small and should not affect the pavement design procedure.

If the number of truck records being used is relatively small, a spreadsheet program on a microcomputer can be used to calculate truck types and ESALs using the formulas found in Appendix MM of the AASHTO pavement design guide (AASHTO, 1986). Since a typical spreadsheet can only load about 16,000 records at a time and the time required to run calculations on all of these records can take hours, it may be more feasible when working with data from the busier weigh sites to run calculations using average axle group weights for each truck type. (The Woodburn port of entry weighs 20,000 trucks a month, even with a sorter system in use.) Another possibility would be to calculate a WIM-type vehicle code and flexible and rigid ESALs at the time a vehicle statistic record is generated and to store this data as part of the record. Figures 4.1 and 4.2 show summaries of ESALs by truck type at one Oregon port of entry and for all ports of entry for one hour in May 1993.

4.2 Commodity Data Applications

ODOT's Strategic Planning unit would like to be able to compare commodity movements by truck with commodity movements by rail and marine modes, for which good data is available. With good truck commodity data, the unit could determine seasonal, annual, and directional commodity flows; perform economic analyses; locate truck movements that might indicate a need for highway improvements; as well as perform other studies that would help meet its obligations under the Oregon Transportation Plan.

Although the weighmasters presently collect truck commodity data, the form in which the data are coded provides little help to other units. The coding system used since 1979 identifies some of the most common commodities carried by trucks in Oregon, as Table 4.3 shows.

In 1988, at the request of the PUC, the three hazardous materials codes were replaced with 20 codes corresponding to the designations found on hazardous material truck placards (Table 4.4). This change helped the PUC when it conducted an audit of a trucking company, by letting it determine whether the company was transporting commodities outside of its authority. If a truck's placard contained a 4-digit code indicating a specific hazardous material, this code was entered in place of one of the 2-digit codes shown below.

Figures from
Phase 1
report
ever in W.P.

Farewell Bend

Vehicle Type	Trucks	Avg. GVW	Max. GVW	Avg. Flexible ESALs	Max. Flexible ESALs	Total Flexible ESALs	Avg. Rigid ESALs	Max. Rigid ESALs	Total Rigid ESALs
EMPTY	5	00	00	0.00	0.00	0.00	0.00	0.00	0.00
UNKNOWN	0					0.00			0.00
3	4	24400	31400	0.73	1.66	2.92	0.10	0.23	0.40
5	1	17800	17800	0.09	0.09	0.09	0.02	0.02	0.02
6	1	28600	28600	0.77	0.77	0.77	0.10	0.10	0.10
8	1	33300	33300	0.36	0.36	0.36	0.07	0.07	0.07
9	0					0.00			0.00
10	0					0.00			0.00
11	57	63900	111000	1.39	10.16	78.95	2.20	18.74	125.55
12	0					0.00			0.00
13	5	58700	76700	1.16	2.80	5.78	0.83	1.85	4.13
14	1	93300	93300	4.21	4.21	4.21	1.38	1.38	1.38
15	9	52800	70000	0.94	2.65	8.49	0.36	1.89	3.25
16	2	80000	90500	0.80	1.15	1.59	0.15	0.21	0.30
17	3	99600	113900	1.86	3.15	5.58	13.38	23.18	40.13
18	6	73500	109200	1.41	3.75	8.46	1.73	4.74	10.37
19	0					0.00			0.00
Grand total	95	58800	113900	1.23	10.16	117.22	1.95	23.18	185.69

Figure 4.1. Sample ESALs Summary for Farewell Bend, May 11, 1993, 7-8 a.m.

Total — All Ports of Entry

Vehicle Type	Trucks	Avg. GVW	Max. GVW	Avg. Flexible ESALs	Max. Flexible ESALs	Total Flexible ESALs	Avg. Rigid ESALs	Max. Rigid ESALs	Total Rigid ESALs
EMPTY	15	700	10700	0.01	0.12	0.12	0.01	0.11	0.11
UNKNOWN	0					0.00			0.00
3	11	24600	31400	0.76	1.66	8.36	0.10	0.23	1.13
5	4	27300	41100	0.39	0.77	1.57	0.28	0.88	1.13
6	1	28600	28600	0.77	0.77	0.77	0.10	0.10	0.10
8	4	32800	35100	0.31	0.41	1.24	0.06	0.08	0.24
9	3	55100	60000	1.41	1.84	4.23	1.40	1.73	4.20
10	2	38300	52400	0.62	1.15	1.23	1.17	2.28	2.35
11	201	65700	111000	1.43	10.16	286.87	2.26	18.74	454.95
12	13	67600	79400	1.46	2.12	18.94	0.29	0.49	3.82
13	27	72000	80500	2.24	3.11	60.56	1.42	2.25	38.31
14	4	79300	93300	2.42	4.21	9.69	0.81	1.38	3.23
15	20	61000	96500	1.30	3.71	25.90	1.09	5.62	21.87
16	4	80300	90500	1.17	2.33	4.67	0.20	0.39	0.82
17	17	84400	113900	1.25	3.15	21.19	5.78	23.18	98.22
18	17	85400	109200	1.53	3.75	25.94	1.70	4.74	28.98
19	2	98900	106500	0.94	1.21	1.88	1.47	1.93	2.93
Grand total	345	63100	113900	1.37	10.16	473.16	1.92	23.18	662.38

Figure 4.2. Sample ESALs Summary for All Ports of Entry, May 11, 1993, 7-8 a.m.

Table 4.3 Commodity Codes (1979–1988)

Code	Commodity
0	Empty
1	Logs
2	Other
3	Lumber products
4	Gravel products
5	Machinery
6	Chips, sawdust
7	Hazardous materials
8	Petroleum, compressed gas, corrosives
9	Radioactive

Table 4.4. Hazardous Materials Codes (1988–)

Code	Hazardous material	Code	Hazardous material
30	Blasting agents	47	Hazardous waste
36	Chlorine	49	More than one hazardous material
39	Combustible	36	Non-flammable gas
41	Corrosive	43	Organic peroxide
44	Dangerous	45	Other/unknown haz. material
48	Empty hazardous material	40	Oxidizer
30	Explosives A–B	36	Oxygen
37	Flammable gas	42	Poison
33	Flammable solid	32	Poison gas
33	Flammable solid waste	34	Radioactive

Although the commodity coding system was successful in identifying commodities at rural sites where most trucks were hauling logs or wood products, it was of little help on freeways or on other major highways that carried a wide variety of trucks. Figure 4.3 shows that 85% of the trucks weighed at Oregon ports of entry carried commodities classified as "other." Part of this is due to the fact that some trucks, interstate trucks in particular, consist of an enclosed trailer carrying the trucking company's logo. Unless the driver is asked what he or she is hauling (an infeasible option), there is no way to determine what these trucks are hauling. However, many of the commodities that are being classified presently as "other" could be identified, if only the coding system was expanded. For example, garbage, agricultural products, groceries, and air freight and mail can all be identified by sight or from a company logo on a truck. It should be noted that prior to 1977, the weighmasters classified many more commodities than they presently do; however, those records were kept on paper, which made it very difficult to conduct a commodity study, regardless of the number of codes in use.

An expanded commodity code system was developed and submitted to the Weighmasters unit, the Strategic Planning unit, and the PUC for review and comment. New commodities were included in the list on the basis of their anticipated volume (the amount that these categories would reduce "other") and their usefulness to various units needing specific commodity data. Since this new coding system could not be so complicated that it detracted from the weighmasters' other duties, many identifiable commodities were left off of the list.

The new codes were designed not to conflict with the existing 0–9 coding system, nor with the expanded 2- and 4-digit hazardous materials codes. Commodity coding systems used by the PUC, the federal government, and the United Nations were investigated, but were all

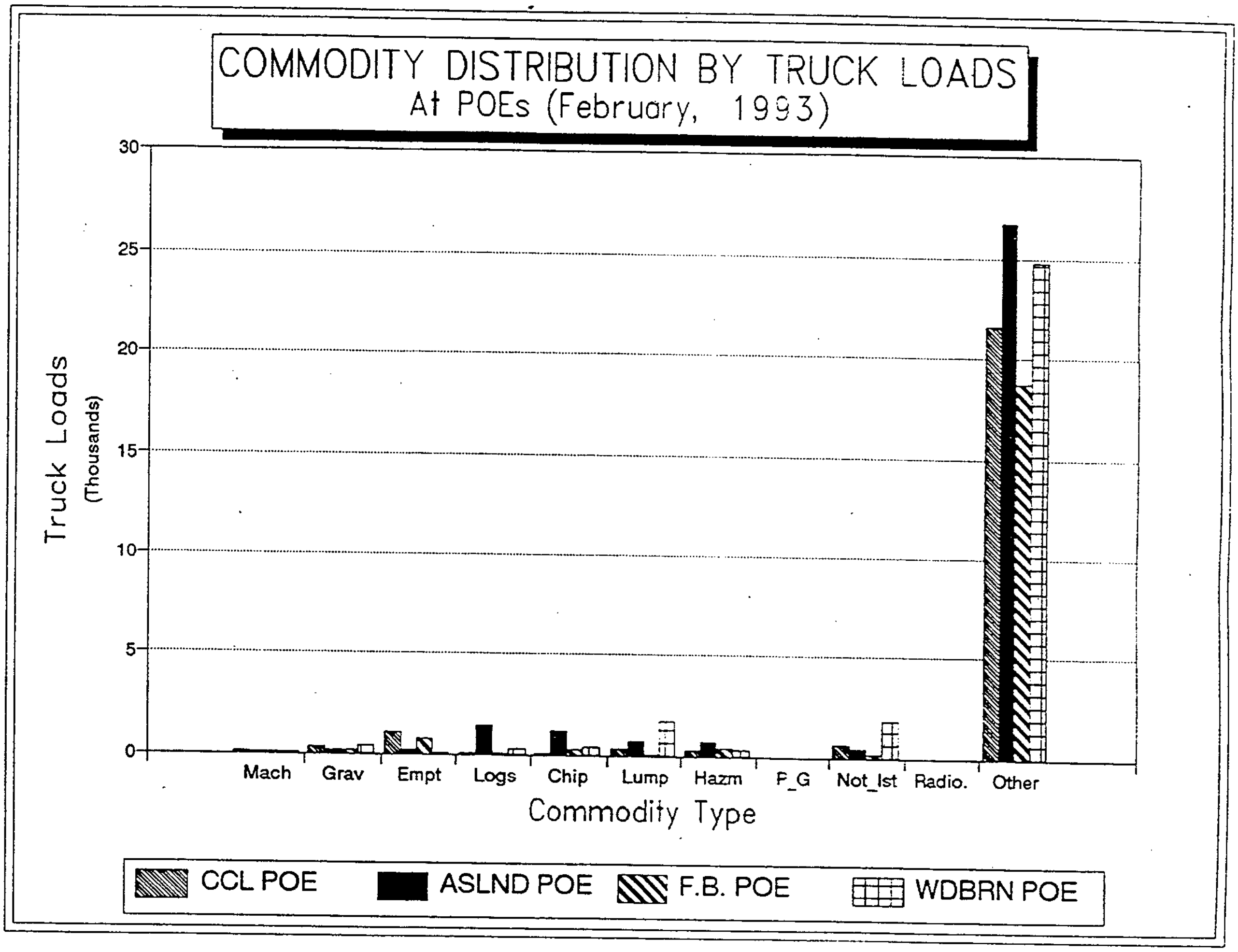

Figure 4.3. Commodities at Ports of Entry, February 1993

determined to be too complex. A preliminary version of the system was tested for month by weighmasters from the Salem district office at four rural weigh sites. The data from two of the four weigh sites for the month of April in 1993 and 1994 is presented in Appendices C and D. Table 4.5 summarizes the 1994 data for all four sites.

Figures 4.4 and 4.5 compare commodity data collected at the four Salem area sites using the old and new commodity codes. The "other" category in Figure 4.4 (using old codes) was reduced by more than 50 percent. The weighmasters adapted to the new commodity code system easily, since in most cases four or five codes amounted for the bulk of the commodities passing through the weigh sites.

After a few modifications were made to the coding system based on the Salem weighmasters' comments, the revised system was tested for a month at three Eugene-area sites and four Roseburg-area sites, including two sites on I-5. The recommended version of the coding system, based on feedback from the Eugene and Roseburg weighmasters, appears in Table 4.6. The new codes were successfully used. Statistical reports for five of the seven sites are presented in Appendix E. Data from the other two sites were not available at the time of going to press.

4.3 Other Applications

Citation data can be used by the weighmasters to create profiles of typical offenders in order to concentrate their enforcement efforts on those trucks. The citation data can be compared by truck type, commodity, trucking company, independent vs. company owned, age, size, and by kind of violation. If it appears, for example, that a particular company's truck

Table 4.5. Salem District Weigh Site Summary — April 1994

Commodity	Ft. Hill	Gates	Eola	Siletz	TOTAL
Logs	72	29	9	35	145
Lumber	16	6	41	0	63
Chips	5	6	21	2	34
Other wood products	0	4	8	0	12
TOTAL wood products	93	45	79	37	254
Produce, nursery	0	1	2	0	3
Grain, seed	0	0	4	0	4
Hay, straw	0	2	5	0	7
Fertilizer	0	0	6	0	6
Live animals	0	0	0	0	0
Beverages	2	2	9	0	13
Food, groceries	1	1	0	0	2
Other ag & food	12	7	21	0	40
TOTAL ag & food	15	13	47	0	75
Cars, light trucks	1	2	1	0	4
Boats	0	1	0	0	1
Tires	1	0	0	0	1
Mobile homes	0	0	1	0	1
Fencing, bldg. matls.	0	0	3	0	3
Other manuf. goods	3	2	1	0	6
TOTAL manuf. goods	5	5	6	0	16
Machinery	2	3	18	5	28
Gravel, sand, dirt	12	4	14	26	56
Asphalt	0	0	0	0	0
Wet cement (mixer)	0	0	1	0	1
Pipes	0	0	6	1	7
Other construction	2	3	6	1	12
TOTAL construction	16	10	45	33	104
Retail store	3	2	4	0	9
Air freight, mail	5	1	2	0	8
Garbage, recycling	1	2	19	1	23
TOTAL general freight	9	5	25	1	40
General haz mat	0	3	5	0	8
Specific haz mat	5	4	2	1	12
TOTAL haz mat	5	7	7	1	20
Other identifiable	4	2	3	1	10
Unknown	33	34	75	5	147
Empty	61	13	87	3	164
TOTAL other freight	98	49	165	9	321
GRAND TOTAL	241	134	374	81	830
% not prev. identified	14.5%	20.9%	25.1%	4.9%	19.4%
% unknown	13.7%	25.4%	20.1%	6.2%	17.7%

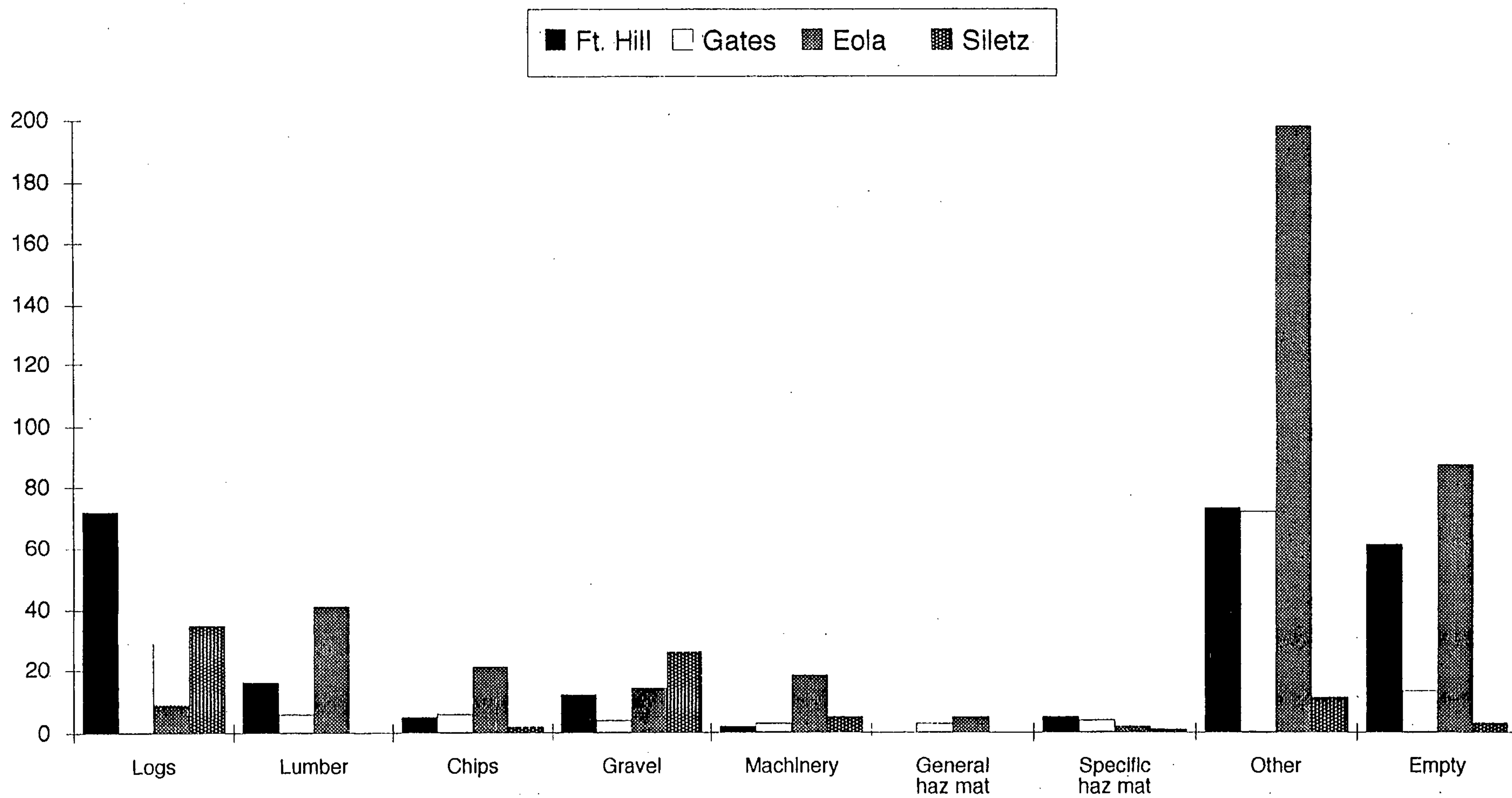

Figure 4.4. Commodity Summary — April 1994 (Old Codes)

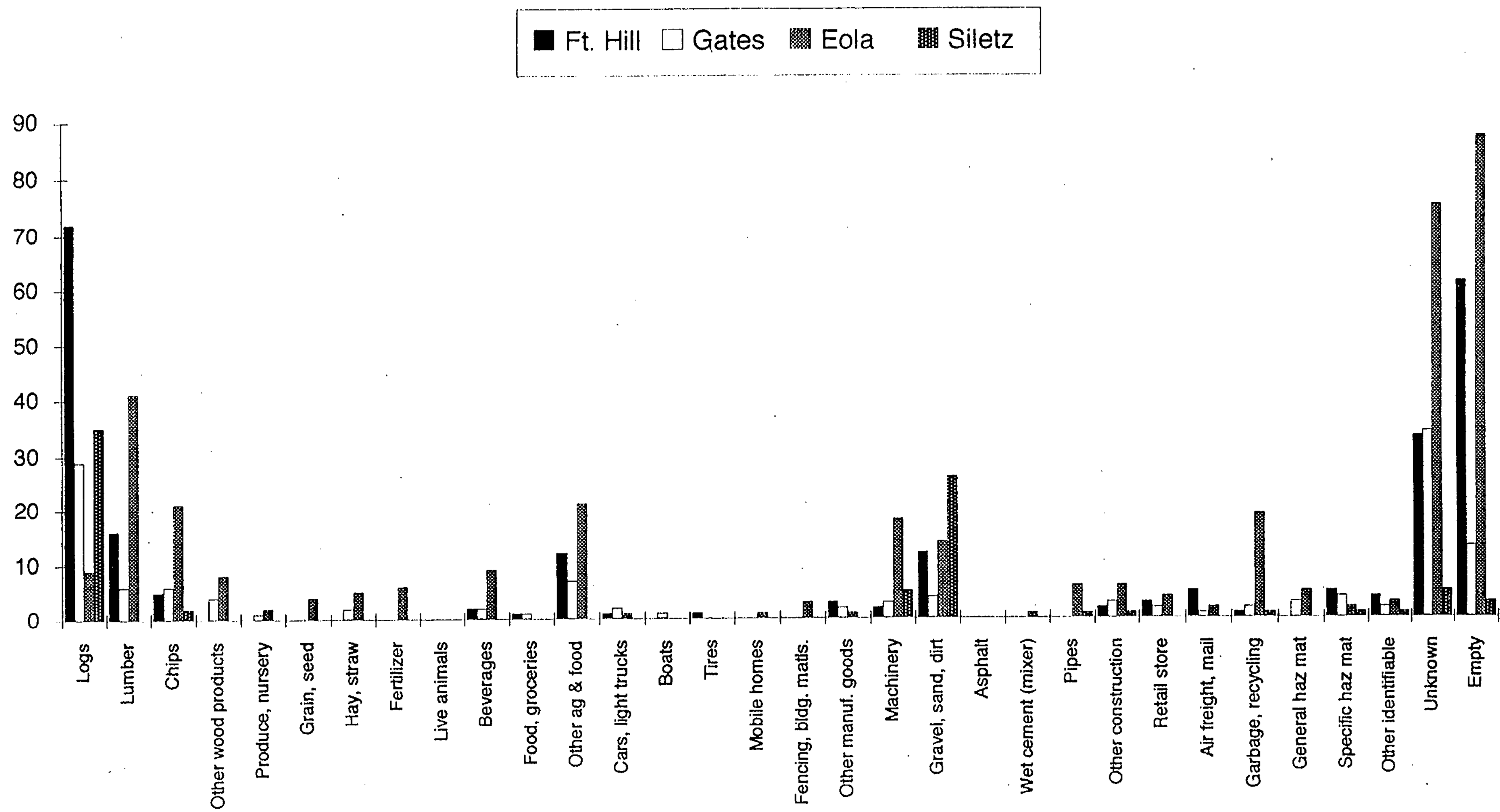

Figure 4.5. Commodity Summary — April 1994 (New Codes)

Table 4.6. Recommended Set of Commodity Codes

Wood Products 10 Logs 11 Veneer 12 Paper, plywood, beams, etc. 13 Chips, hog fuel, sawdust 19 Other wood products	**Agriculture & Food** 20 Produce, nursery products 21 Grain, seed (bulk or sacked) 22 Hay, straw 23 Fertilizer (bulk) 24 Live animals 25 Beverages (bulk, canned, bottled, milk tanker) 26 Food, groceries 29 Other agricultural & food items	**Hazardous Materials** 30 Blasting agents 30 Explosives A-B 32 Poison gas 33 Flammable solid waste 33 Flammable solid 34 Radioactive 36 Chlorine 36 Nonflammable gas 36 Oxygen 37 Flammable gas
Manufactured Goods 50 Cars/light trucks 51 Boats 52 Tires 53 Mobile homes 54 Fencing, roofing, building materials 59 Other manufactured goods	**Construction** 60 Machinery 61 Gravel, aggregate, sand, dirt 63 Asphalt 64 Wet cement (mixer) 65 Pipes 69 Other construction items	39 Combustible 40 Oxidizer 41 Corrosive 42 Poison 43 Organic peroxide 44 Dangerous 45 Other/unknown hazardous material 47 Hazardous waste 48 Empty hazardous materials 49 More than one hazardous material
General Freight 70 Retail store 71 Air freight, mail, newspapers 72 Garbage, scrap, recycling 73 Moving vans 74 LTL freight	**Special Studies** 80-89 Reserved for future ODOT use for short-term commodity studies	**Other Freight** 90 Identifiable commodities not classified elsewhere 95 Unknown—trailer contents not visible or labeled 99 Empty (visibly empty)

Commodity code suffixes:

none	Commodity visually identified
40xx	Commodity determined from logo
50xx	Containerized
60xx	More than one commodity being carried

Examples:

10	Log truck
1203	Gasoline (from ID# on placard)
4071	UPS logo = air freight (guess)
5020	Containerized produce
6065	Primary item (51%+) was pipes

drivers have an unusually large number of logbook violations, the weighmasters can check those drivers' logbooks more carefully during inspections.

Another use of citation data is to spot potential safety problems at specific weigh sites. For example, the Emigrant Hill weigh site is located just before a 6-mile (10-km) 6% downgrade on I-84. If it appears that a significant number of trucks inspected at the station have brake problems, inspections could be conducted more frequently to reduce the potential for runaway trucks on the grade.

The Traffic unit can use the vehicle statistics data from Oregon's weigh stations to supplement the data they already collect at 115 permanent automatic recorder locations. Except at the sites with WIM sorter systems, the database provides truck volumes by vehicle type and number of axles during the sites' hours of operation. This information could be easily incorporated into the unit's annual traffic reports, turning the weigh sites into additional reporting locations.

6.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The following conclusions are drawn from this study:

1. An interactive menu-driven user interface has been developed for an existing database system (Informix) used by ODOT for truck data. This interface will allow users to interact with the system without any knowledge of computers, the database, or Informix. Various reports and graphs summarizing general truck data and citation information can be generated.
2. It is possible to collect detailed truck commodity data without substantially adding to the weighmasters' workload.
3. A preliminary evaluation of the data has been conducted. This revealed that pavement damage factors can be generated from the database. This information is useful for several ODOT units.
4. Citation data can be used to create profiles of typical offenses and offenders, by factors such as truck type, commodity, company, and so on.
5. Another use of citation data is to spot potential safety problems at specific weigh sites. For example, the Emigrant Hill weigh site is located just before a 6-mile (10-km) 6% downgrade on I-84. If it appears that a significant number of trucks inspected at the site have brake problems, inspections could be performed more frequently to reduce the potential for runaway trucks on the grade.

6. The Traffic unit can use the vehicle statistics data from Oregon's weigh stations to supplement the data they already collect. Except at the stations with WIM sorter systems, the database provides truck volumes by vehicle type and number of axles during the stations' hours of operation. This information could be easily incorporated into the unit's annual traffic reports, turning the weigh stations into additional reporting locations.

5.2 Recommendations

The following recommendations are made:

1. Implement the new commodity coding system on a statewide basis.
2. Calculate and store WIM-type commodity codes and flexible and rigid ESALs at the time a vehicle statistics record is generated.
3. Distribute complete sets of vehicle statistics data in CD-ROM format on an annual basis to interested ODOT units.
4. Conduct a study to determine how often a trailer's logo matches its contents.
5. Encourage the use of portable computers at all weigh sites not already equipped with permanently-installed computers.

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APPENDIX A

ODOT DBMS User's Manual

Appendix A

ODOT DBMS User's Manual

A.1. INTRODUCTION

ODOT DBMS is a relational database management system that has been developed at Oregon State University for an IBM-PC or compatible computer systems. The system is consistent with the existing ODOT database in Salem. The DBMS performs data manipulation and performs statistical analysis and generates reports based on user requirements.

The DBMS was developed using the Informix-SE and the Informix-SQL systems. A overview of the Informix system is given in Bell et al. (1993). The DBMS is designed to ensure minimum storage and fast data processing time, and to provide the ability for users to directly access the data. It facilitates user-friendly data entry, data query, report generation, and statistical analysis on the stored data. Users can perform a data entry or query on the database through the PERFORM module of Informix-SQL. This module generates interactive screen forms. During execution, the form program causes the database to display the requested data on the screen in the specified format. Furthermore, ACE (the report generator for Informix-SQL) can control and format the information that is returned from an SQL query. It compiles a specification into a program that users can run whenever they want to produce that report. Also, utilities built into Informix-SE allow users to load and unload ASCII data or worksheet files into or out of the database for statistical analysis.

The DBMS developed in this research is menu-driven. A typical user may not be familiar with Informix software or database concepts. The system provides all necessary information to develop and execute an application. This manual explains how the system is used.

A.2. Start-up and DBMS menu options

It is assumed that Informix and the application software developed in this research are loaded in the C drive. To access the menu system, the user types TRUCKDB at the C> prompt:

```
C:> TRUCKDB
```

A start-up menu is displayed on the screen. The choices in this menu are:

1. Start the ODOT DBMS User-Menu
2. Use INFORMIX-SQL (for sophisticated users only)
3. Exit

After selecting Options 1 or 2, the first information to be requested will be the user name and password. Security is enforced to ensure data integrity. The prompt will be:

```
DOS/16M Protected Mode Run-Time        Version 4.20a
Copyright (C) Rational Systems, Inc. 1987 - 1992
user name:
password:
```

If the user name and password are recognized by the system, it will lead to next sub-menu. Option 3 leads to exiting the system.

The first option in the start-up menu will lead users to the ODOT DBMS main menu. The second option, designed for sophisticated users only, leads to Informix-SQL main menu. The following choices are available in the Informix-SQL main menu:

Form	: Run, Modify, Create, or Drop a form
Report	: Run, Modify, Create, or Drop a report
Query-Language	: Use Informix SQL
User-menu	: Run or Modify a custom-built menu
Database	: Select, Create, or Drop a database
Table	: Select, Create, or Drop a database table
Exit	: Exit Informix-SQL

Besides being familiar with the Informix-SQL system, the user should have the authorization to select/create/drop a database/table. Its use is generally limited to the database administrator. For details about Informix-SQL, see the Informix-SQL manual (Informix Software, Inc., 1992).

This user manual focuses on the ODOT DBMS user menu system (Option 1). The menu in Figure A.1 is displayed when the first option is selected. The user can use space bar, arrow keys, or type the selection number to make a selection; an 'e' to return to previous menu or exit the system. A selection must be followed by <RETURN> to execute a selection.

There are five main menu options available in the menu-

ODOT Truck DBMS
User-Menu Outline

I. USE DATA ENTRY FORMS

STATISTICAL DATA ENTRY/QUERY FORM
CITATION ENTRY/QUERY FORM

II. RUN REPORTS

STATISTICAL REPORTS
- Commodity Distribution - Truck Loads
- Commodity Distribution - Percentages
- Hazardous Material Distribution

CITATION REPORTS
- Citation Summary
- Drivers' Demographics
- Commodity List
- Equipment Violation
- Permit Violation
- Vehicle Size Violation
- Driver Violation

III. DISPLAY DATABASE TABLE DEFINITIONS

"STATISTIC" TABLE
"CITATION" TABLE
"WSCLASS" TABLE
"HAZMATL" TABLE

IV. DOWNLOAD DB TABLE INTO ASCII FORMAT

"STATISTIC" TABLE
"CITATION" TABLE
"WSCLASS" TABLE
"HAZMATL" TABLE

V. SCAN FOR MISMATCHING DATA

"STATISTIC" TABLE
"CITATION" TABLE
"WSCLASS" TABLE
"HAZMATL" TABLE

Figure A.1. User-Menu for ODOT DBMS

driven system, as shown in Figure A.1. Options I and II perform data entry/query and report generation. Option III displays the database table definitions or schema. Option IV downloads database tables into ASCII format or worksheet files for spreadsheet or statistical analysis. Option V compares the data in a table with its indexes to determine if the data or indexes might be corrupted.

A.3. Use Of Data Entry Forms

From the main menu of Figure A.1, selecting "USE DATA ENTRY FORMS" will display the following choices:

1. STATISTICAL DATA ENTRY/QUERY FORM
2. CITATION ENTRY/QUERY FORM

The first selection is for data entry/query for the "STATISTIC" table, while the second selection is for the "CITATION" table. The first option displays the form of Figure A.2. This form is used to enter/modify/query data in the "STATISTIC" table. The options shown at the top of the form (Figure A.2) are used as follows:

Query : search the active database table
Next : show the next row in the current list
Previous: show the previous row in the current list
View : run editor commands to display BLOB contents
Add : add a row to the active database table

```
PERFORM: Query  Next  Previous  View  Add  Update  Remove  Table  Screen
        Current  Master  Detail  Output  Exit
                                                ** 1: statistic table **
+--------------------------------------------------------------------------+
|                          WIM STATISTICAL DATA                            |
+--------------------------------------------------------------------------+
|    Puc #: [    ]   Vehicle Owner :[     ]   Weigh site :[    ]            |
|                                                                          |
|    Weigh Time Code :[  ]             Weigh date:  [     ]                |
|                                                                          |
|    Vehicle type:  [     ]  # of Axles :[         ]   Commodity: [    ]    |
|                                                                          |
|    Weigh time:    [     ]   Gross weight (100s of lbs) :[    ]           |
|                                                                          |
|    Warning:       [     ]   Reason:         [    ]                       |
|                                                                          |
|    Axle group weights:                                                   |
|                                                                          |
|    ----------------------                                                |
|                                                                          |
|    Group #1:    [       ]          Group #2:      [     ]                |
|                                                                          |
|    Group #3:    [       ]          Group #4:      [     ]                |
|                                                                          |
|    Group #5:    [       ]          Group #6:      [     ]                |
|                                                                          |
|    Group #7:    [       ]          Group #8:      [     ]                |
|                                                                          |
|    Group #9:    [       ]          Group #10:     [     ]                |
|                                                                          |
|    Group #11:   [       ]          Group #12:     [     ]                |
|                                                                          |
|    Weighmaster # :[   ]             CPU process time :[   ]              |
+--------------------------------------------------------------------------+
```

Figure A.2. Entry/Query Form for "STATISTIC" Table

Update : change a row to the active database table

Remove : delete a row to the active database table

Table : select the current table

Screen : show the next page of the form

Current : display the current row of the current table

Master : select the master table of the current table

Detail : select a detail table of current table

Output : output selected rows in forms or report format

Exit : return to the previous menu

When the user selects the Query option, the system requests a search criterion. The search criteria determines the rows (i.e., data) that are returned in a database query. The user can search for an exact match or use operators to specify the particular row or rows needed. The Next and Previous options can be used to scan through the current list, while the Screen option is to move to the next page of a multiple-page screen form. Also, users can use the Output option to save the results of a query in a system file. For more details on database query, see Chapters 4 and 5 of Informix-SQL User's Guide (Informix Software Inc., 1992).

A.4. Run Reports

Selecting "RUN REPORTS" option in Figure A.1 displays the following choices:

1. STATISTICAL REPORTS

2. CITATION REPORTS

There are three commodity distribution reports available for the statistic table, seven citation reports are available through the second option. These reports are listed in Figure A.1.

when either STATISTICAL REPORTS or CITATION REPORTS is selected, the user is provided with a list of reports. After a report is selected, the user is asked to enter the beginning and ending dates for the report. The prompt will be:

```
Enter beginning date for the report (MUST be in the format YYMMDD):
Enter ending date for the report (MUST be in the format YYMMDD):
```

After this data entry, a report is generated and saved in a ASCII data file. An example of the Citation Summary report file is shown in Figure A.3. Additional examples are given in Appendix C.

A.5. Display Database Table Definitions

This option is used to view the table definitions for the database tables used in this research. The tables included in this research are the "STATISTIC" table, the "CITATION" table, the "WSCLASS" table, and the "HAZMATL" table. The fields (name and definition) for these tables are shown in Figures A.4 - A.7.

A.6. Download Database Table Into ASCII File

This selection is used to download the database tables into ASCII files. It can be used for spreadsheet and statistical

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CITATION SUMMARY

from: 02-01-93 to: 03-01-93

====================================

Report run date: June 15, 1994

			OVERWEIGHT				TRK	NON-	OVER	NO
SITE	NAME	AX	TA	GA	VEH	COM	SFTY	WT	SIZE	PUC
0307	BRIGHWD WB		2	1						
0308	BRIGHWD EB	2	5						1	1
1404	CCL POE	12	85	55	2	23	9	10	8	
1502	WHTE CITY	1	1	2		1				
1504	ASLND NB	1	2	1			1	1		1
1506	ASLND SB		7				2			3
1507	ASLND POE	10	75	39		8	2	2	7	
1509	LAKE CRK	1	5	7		4	5			
1701	GRNT PASS		3			1				
2304	BALE		9	6		4			2	20
2305	OLDS FERRY	3	14	15	1	2		1	1	14
2306	F.B. POE	3	48	22		10	10	1	9	
2307	BURNS JCT			1		2				4
2402	HUBBD SB	3	4	4		1	1	2		
2407	HUBBD NB	1	3	3			1			
2408	WDBRN NB	5	39	15	1	5	2	4	4	2
2409	WDBRN POE	32	133	49	1	17	7	21	10	1
2903	TILLAMOOK		4	8						
3602	DAYTON		2	3		2			1	1

AX - single axle overload
TA - tandem axle overload
GA - group overload
VEH - vehicle overload
COM - combination overload
TRK_SFTY - truck safety
NON_WT - non_weigh violation
OVERSIZE - vehicle size violation
NO_PUC - not registered with PUC

Figure A.3. Citation Summary Report (Feburary, 1993) analysis and as an input file for any post-processing.

A.7. Scan For Mismatching Data

The user can use this utility to compare the data in a table with its definition and data type to determine if there is a mismatch. It will check whether the data or the indexes might be corrupted because of a power failure, computer crash, or other abnormal program stoppage.

Field Name	**Field Type**
s puc no	char(6)
s name	char(5)
s station	char(4)
s wdatetime	integer
s wdate	char(6)
s vtype	smallint
s axles	smallint
s commodity	char(4)
s com rmrks	char(6)
s gweight	smallint
s warning	char(6)
s reason	char(1)
s wgt1	smallint
s wgt2	smallint
s wgt3	smallint
s wgt4	smallint
s wgt5	smallint
s wgt6	smallint
s wgt7	smallint
s wgt8	smallint
s wgt9	smallint
s wgt10	smallint
s wgt11	smallint
s wgt12	smallint
s weighmaster	char(3)
s ptime	smallint

Figure A.4 "STATISTIC" Table Definition

Field Name	Field Type	Field Name	Field Type	Field Name	Field Type
c_udate	integer	c_vnum	char(12)	c_ts_viol_desc	char(50)
c_wdate	char(6)	c_veh_state	char(2)	c_np_viol	char(1)
c_station	char(4)	c_puc_no	char(6)	c_fc_viol	char(1)
c_cite_no	char(10)	c_vyear	char(2)	c_fc_desc	char(36)
c_action	char(1)	c_vmake	char(3)	c_ov	char(1)
c_org_no	char(10)	c_vmodel	char(5)	c_pv_other	char(1)
c_cdate	char(6)	c_vstyle	char(5)	c_other_desc1	char(25)
c_ctime	char(4)	c_co_num	char(10)	c_other_desc2	char(25)
c_c_ampm	char(1)	c_crime	char(1)	c_rmrks1	char(40)
c_dlast	char(18)	c_infraction	char(1)	c_rmrks2	char(40)
c_dfirst	char(15)	c_weight	char(1)	c_statute	char(18)
c_dmiddle	char(15)	c_pv_wt	char(1)	c_comm_desc	char(12)
c_daddr	char(48)	c_sa_oload	char(1)	c_comm_code	char(4)
c_dcity	char(25)	c_ta_oload	char(1)	c_oname	char(33)
c_dstate	char(2)	c_ga_oload	char(1)	c_oaddr	char(33)
c_dzip	char(10)	c_veh_oload	char(1)	c_ocity	char(13)
c_d_differs	char(1)	c_comb_oload	char(1)	c_ostate	char(2)
c_d_ht_ft	char(1)	c_wt_allege	char(6)	c_ozip	char(10)
c_d_ht_in	char(2)	c_wt_allow	char(6)	c_atime	char(4)
c_d_wt	char(3)	c_size	char(1)	c_a_ampm	char(1)
c_dsex	char(1)	c_pv_size	char(1)	c_aday	char(2)
c_drace	char(3)	c_width	char(1)	c_amonth	char(3)
c_d_eyes	char(3)	c_height	char(1)	c_ayear	char(2)
c_d_hair	char(3)	c_length	char(1)	c_bail	money(9,2)
c_ddob	char(6)	c_sz_allege_ft	char(3)	c_weighmaster	char(3)
c_doprnum	char(15)	c_sz_allege_in	char(2)		
c_d_phone	char(10)	c_sz_allow_ft	char(3)		
c_hazmat	char(1)	c_sz_allow_in	char(2)		
c_cdl	char(1)	c_ts_viol_d	char(1)		
c_employ	char(1)	c_ts_viol_e	char(1)		

Figure A.5 "CITATION" Table Definition

"WSCLASS" Table

Field Name	Field Type
w st id	char(4)
w st bname	char(10)
w st name	char(20)
w int state	char(1)
w nation hw	char(1)
w accs or	char(1)
w primary	char(1)
w secondary	char(1)
w county	char(1)
w poe	char(1)

"HAZMATL" Table

Field Name	Field Type
h id code	char(4)
h odot code	char(2)
h comm desc	char(50)

Figure A.6 "WSCLASS" and "HAZMATL" Table Definitions

APPENDIX B

GRAPHER User's Guide

Appendix B

GRAPHER User's Guide

B.1. INTRODUCTION

GRAPHER is a graphic application software specifically designed for post-processing of ODOT DBMS system. It is developed using Quattro Pro macro programming and is intended for both novices and experienced users. The program interacts with the Windows environment and generates reports and graphs. The use the system is explained below.

It is recommended that users make a copy of the system disk. The disk contains all the files necessary to run GRAPHER. It is assumed that Microsoft Windows 3.0 or later and Quattro Pro for Windows 5.0 or later have been installed on the machine before the user runs the application. The user needs to copy all the files on the system disk to the C drive. The GRAPHER program is then loaded by typing GRAPHER at the C> prompt:

C> GRAPHER

This manual is organized into three main sections and follows certain conventions to help make this guide easier to read. All commands, for example, appear as they do on the screen, with a vertical bar separating each command keyword in a sequence like File|Open. User inputs are bold-faced when they appear within the body of a paragraph -- for example, "type **Commodity Distribution** and press Enter."

B.2. MANAGING FILES

B.2.1 Opening Existing Files

When the user first starts the program, the screen in Figure B.1 appears showing a dialogue box. The user selects an existing report file to use.

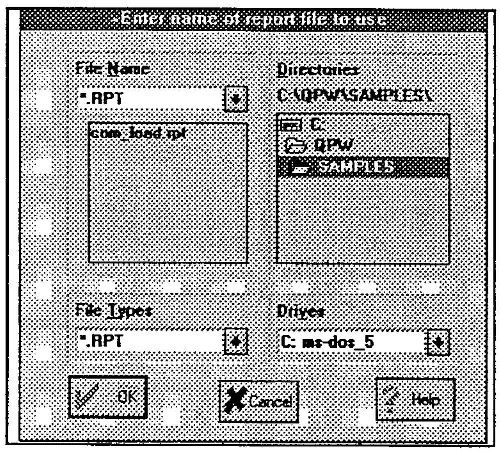


Figure B.1 Prompt asking for a report file name to use

The report files (*.RPT) in the current directory are displayed for selection. To select a file to open, simply double-click on its name in the list box. The user can also use t`he File|Open command to open report files with different file type, for example, an existing Quattro Pro file. The user opens the File Types box and select *.WB1. Only the Quattro Pro for Windows worksheet files in the current directory will now appear in the File Name list box. The user can then select the desired file. When the user makes a selection, the program loads the report file into a notebook window, converting it to its designed format and generating graphs in the process. After the user selects a report file, say COM_LOAD.RPT, to load into the notebook, the window in Figure B.2 is displayed on the screen.

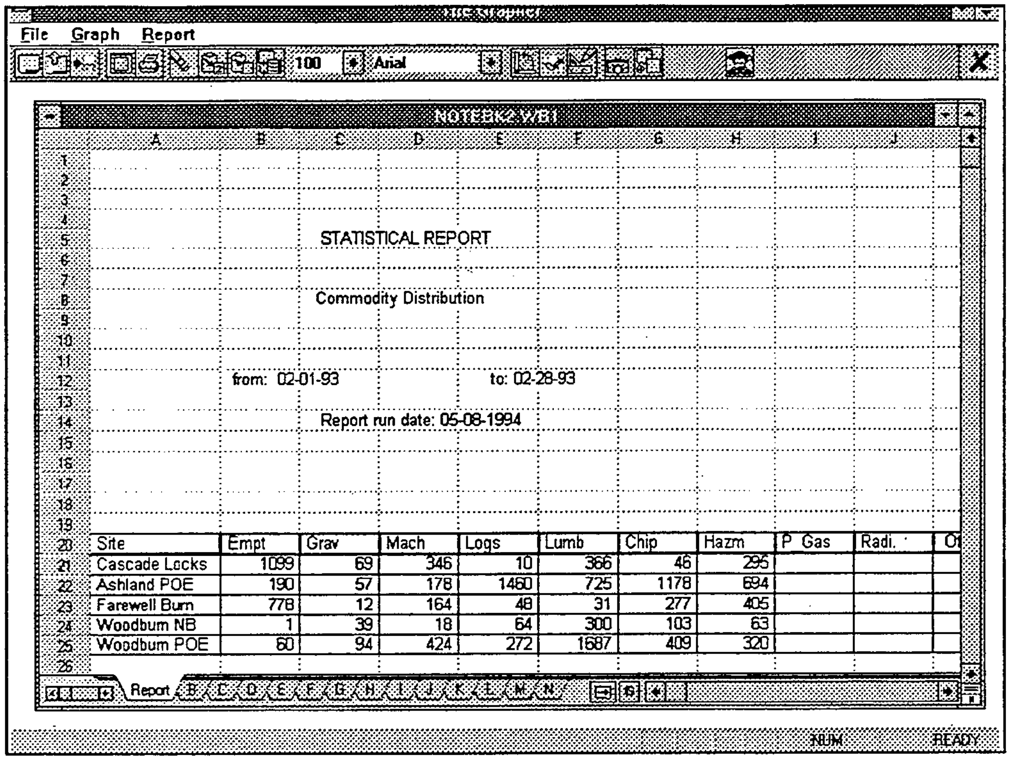


Figure B.2 A Full Screen View for GRAPHER

B.2.2 Saving a File

To save a new file for the first time, the user can use either the File|Save or File|Save As commands. When the user selects one of these commands, the dialog box in Figure B.3 prompts the user to specify a name under which to save the current file. The default name for the current report file appears in the File Name box. The user can use this name or type in a new name. The user can also select a different directory, a different file type, and a different drive. When the user finishes typing, press Enter or click on OK. The program will then save the current report file under the name specified.

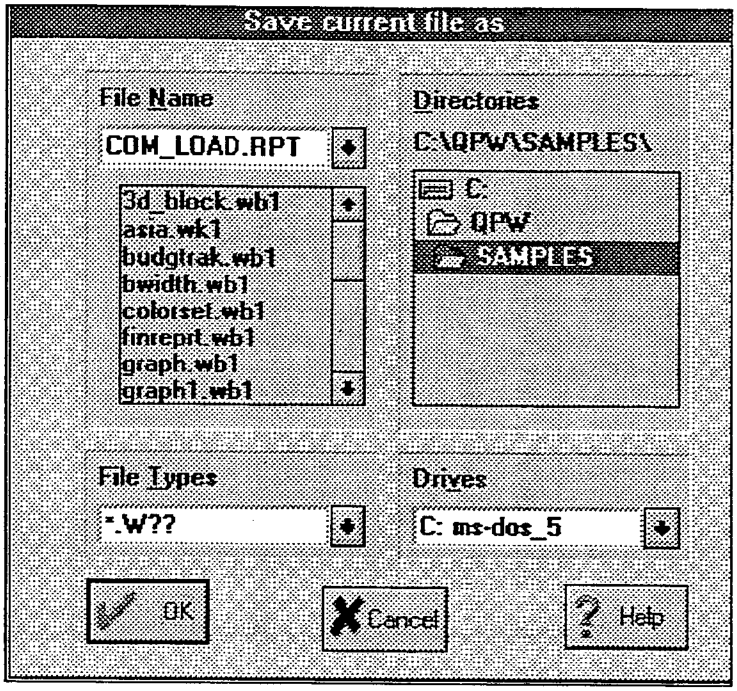


Figure B.3 File Save Dialog Box

If the user types in an invalid file name or non-existing drive, a beep will sound and an error message will appear on the screen as shown in Figure B.4.

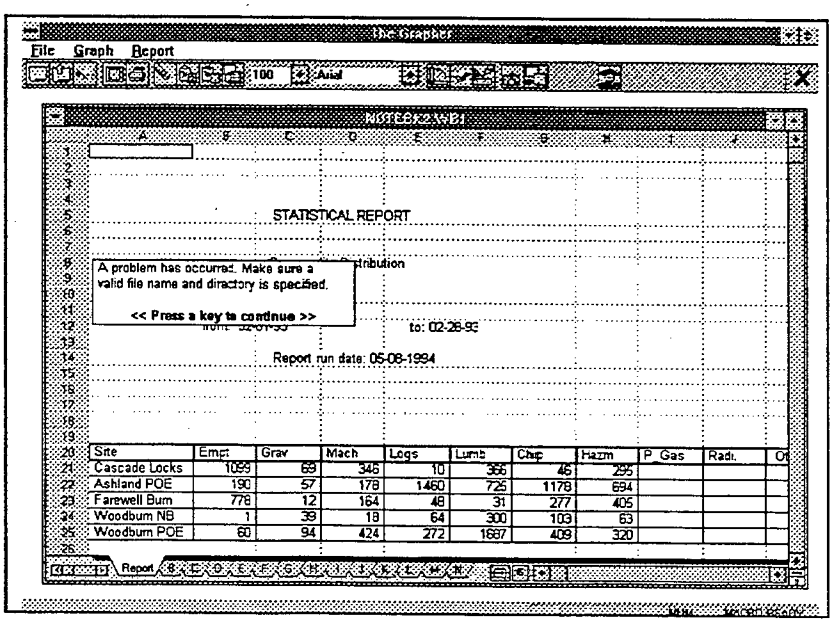


Figure B.4 File Saving Error Message

B.2.3 Exit the Application

To exit the GRAPHER, select File|Exit command. If the current report file has not been saved, a warning message will be displayed asking for a prompt action: *Yes* -- exits the program, *Cancel* -- returns the user to the current report file.

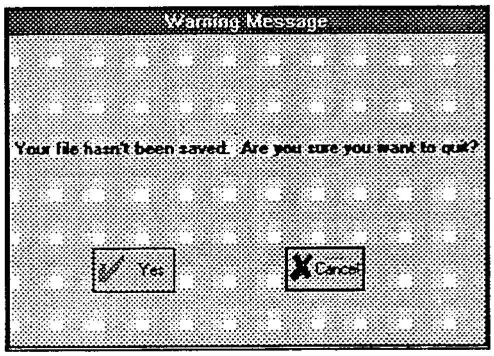


Figure B.5 Warning Message

B.3 USING GRAPHS

There are three options available under the Graph Menu: Edit a Graph, View a Graph, and Print a Graph, as shown in Figure B.6.

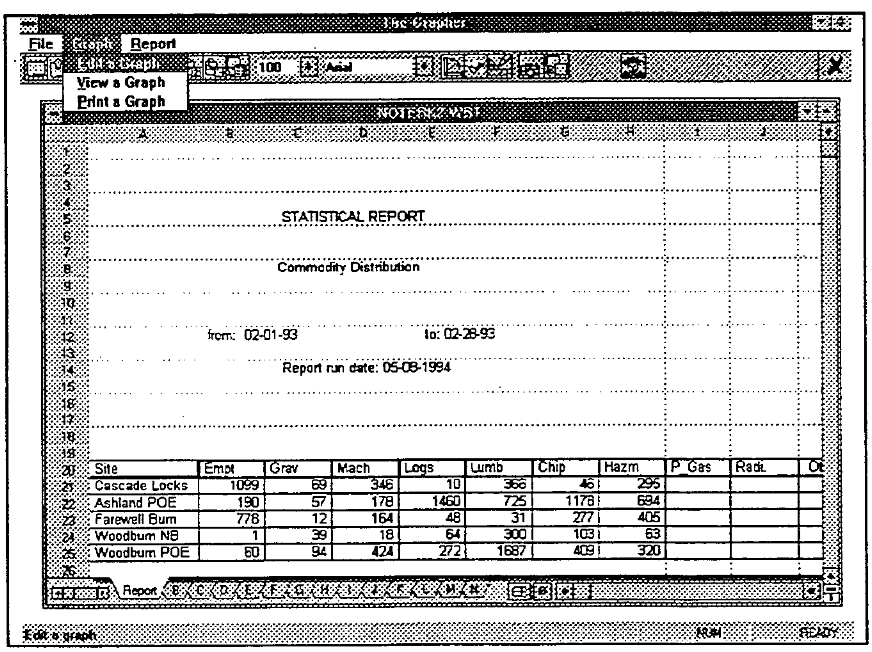


Figure B.6 Using Graphs

The program offers an easy way to build/edit a graph. When a report file is loaded into the current notebook, several graphs are built automatically: a bar chart presenting the data from all sites in the report file being loaded, and a pie chart for each site. When the user uses the Graph|Edit a Graph or Graph|View a Graph, a dialog box showing a list of available graphs is displayed for the user to select an option.

As shown in Figure B.7, the Graph List dialog box lists all graphs available with the report file: *All* is the bar chart presenting the data from the all sites, *Cascade Locks* is a pie chart presenting the data from the Cascade Lock POE, etc.

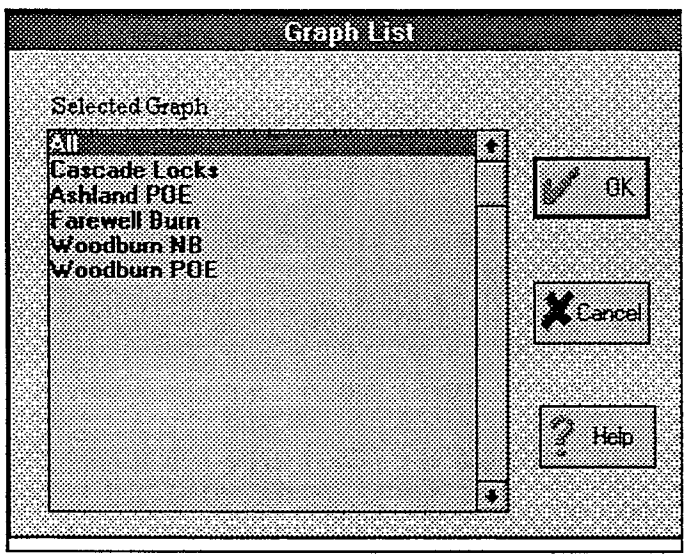


Figure B.7 Selected Graph List

To select a graph to view/edit, either double-click on its name in the list box or highlight the graph name on the list box and click on the OK button. When the user makes a selection, the program loads the graph into the active window for editing/viewing.

B.3.1 Editing a Graph

Graph is treated as a separate entity within a notebook file. It appears in its own window which the user can manipulate -- open, close, minimize, maximize, and resize. On the other hand, displaying a graph full screen allows the user to view how it will actually appear in final output form.

A graph consists of many components. Each component has its own properties. A 2-D graph, for example, has a total of eleven components as shown in Figure B.8.

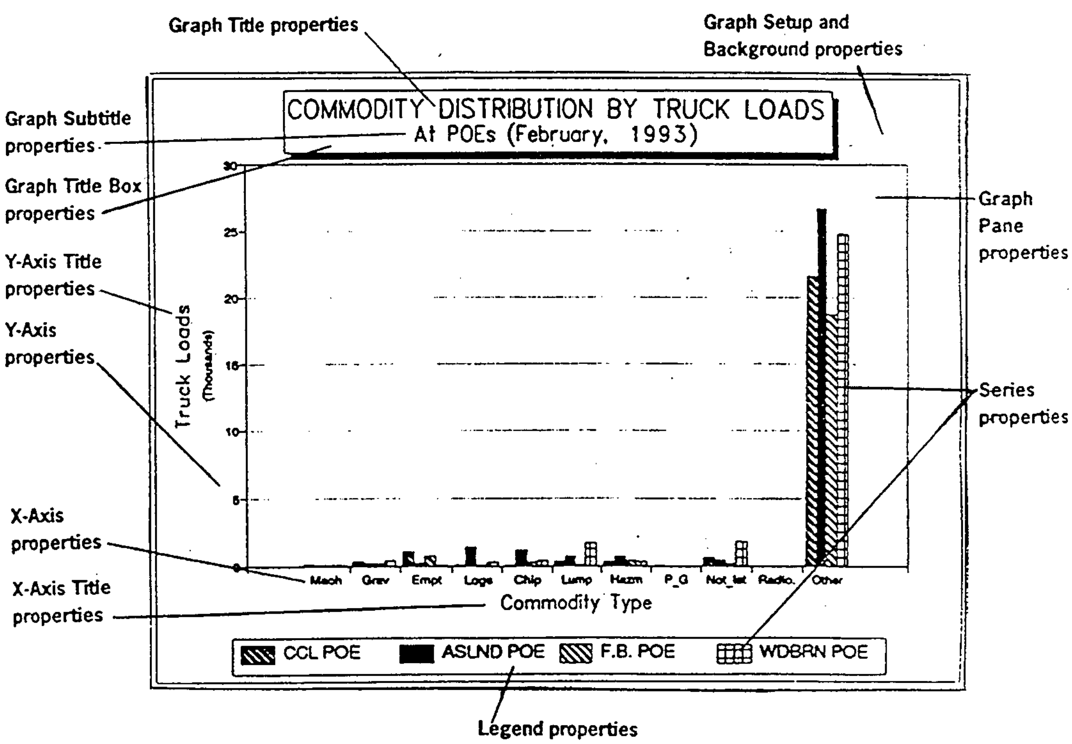


Figure B.8 2-D Graph Components and Its Properties

The user can assign/change properties of any of the components in a graph by accessing property menus. Quattro Pro for Windows uses right-click on the mouse to access a property menu. For example, to access the property menu for the Graph Setup and Background properties, first click anywhere within the area to select it. Then right-click to access the property menu for the Graph Setup and Background. As shown in Figure B.9, a dialog box showing all properties for the Graph Setup and Background is displayed for the user to assign/change.

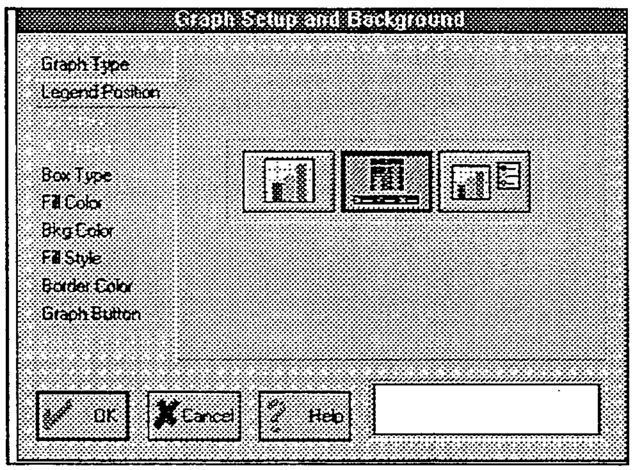


Figure B.9 Graph Setup and Background Property Menu

To assign the Legend properties, right-click on the Legend properties area, a dialog box will appear as shown in Figure B.10.

The user can change properties of Legend Position, Text Color, Text Bkg Color, Text Font, Text Style, Box Type, Fill Color, Bkg Color, Fill Style, and Border Color.

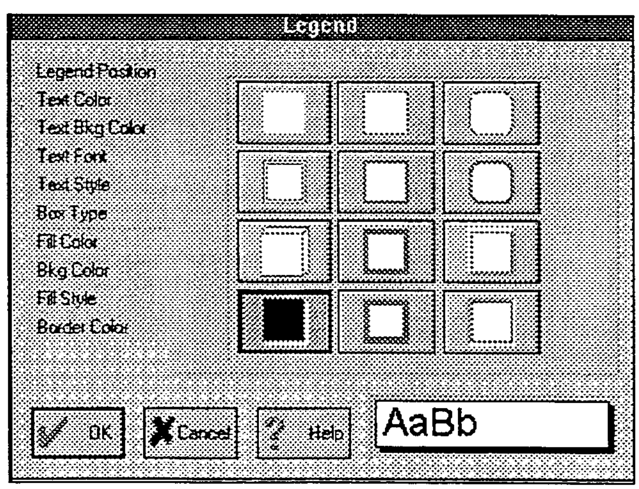


Figure B.10 Legend Properties

A similar procedure follows for assigning properties of other components. The user just right-clicks the area of the component to access its property menu, and then select the desired properties.

To assign/change Graph Titles, Graph Type, and Graph Series, right-click anywhere on the graph and select the Graph Titles/Graph Type/Graph Series to edit. As shown in Figure B.11, Graph Titles, for example, has a dialog box asking the user to type the Main Title, Subtitle, X-Axis Title, Y1-Axis Title, and Y2-Axis Title.

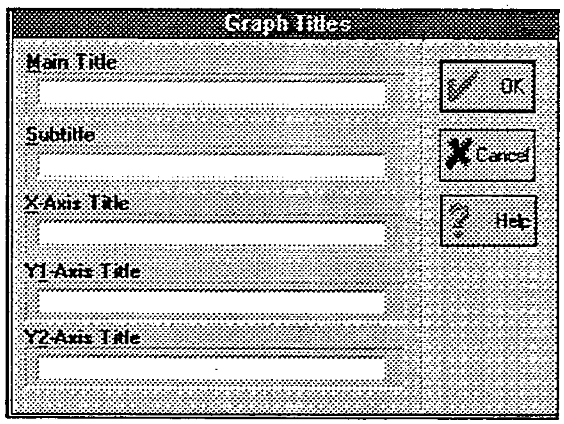


Figure B.11 Graph Titles

After finishing assigning properties for all graph components, the user clicks on the *Close* button to back to the main report file window.

B.3.2 Viewing an Existing Graph

To view an existing graph, use Graph|View a Graph command. A graph list will be shown as in Figure B.7 for the user to select a graph to view. When the user selects a graph from the graph list, a full screen graph will be displayed for the user to view as it actually appears in final output form. To change anything on the graph, he needs to use the Graph|Edit a Graph commands described in the previous section.

B.4. PRINTING

The program offers report printing and graph printing. The user can print a standard report or any graph from the report file. Make sure a printer is ready when using print commands.

To print a standard report, use Report|Print the Report command as shown in Figure B.12.

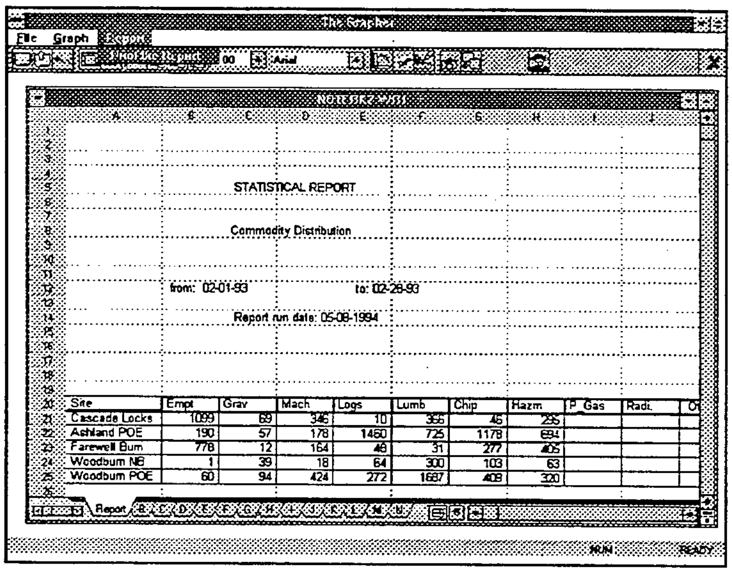


Figure B.12 Report Printing

To print a graph, use Graph|Print a Graph command. Again, a graph list is displayed for the user to select a graph to print. The user selects a graph name from the graph list and clicks on the *OK* button. A sample graph is shown on Figure B.13.

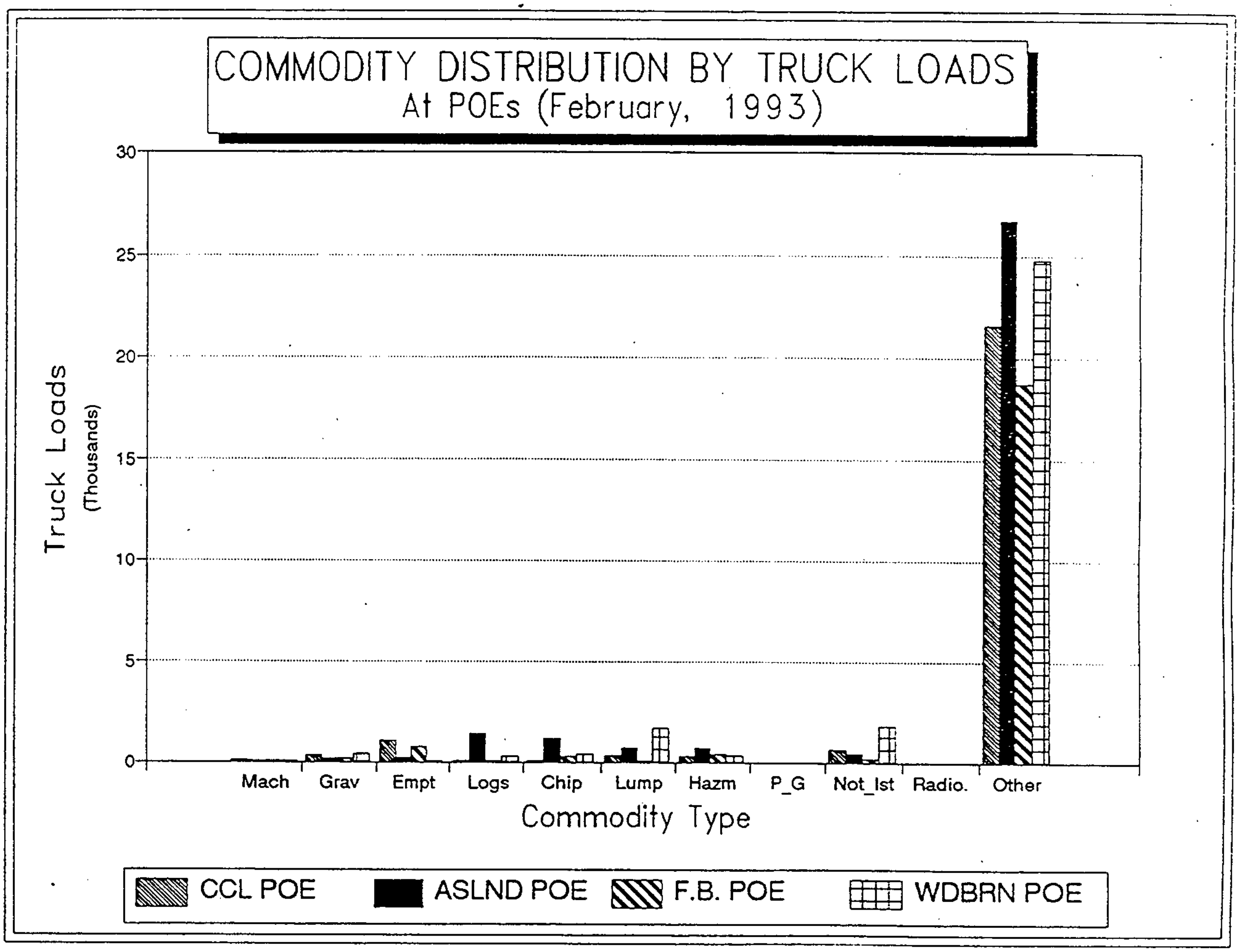


Figure B.13 Sample Graph of Commodity Distribution By Truck Loads

APPENDIX C

Statistical Reports for Fort Hill and Gates Sites, April 1993

STATISTICAL REPORT

====================================

Commodity Distribution
(Truck Loads)

from: 04-01-93 to: 04-30-93

====================================

Report run date: May 15, 1994

				Wood Products			Dangerous Materials				
ight ation	Empt	Grav	Mach	Logs	Lumb	Chip	Hazm	P_Gas	Radi.	Other	Unknw
TES	8	9	9	23	30	16	5			144	11
RT HILL	80	2	5	321	56	27	4			186	18

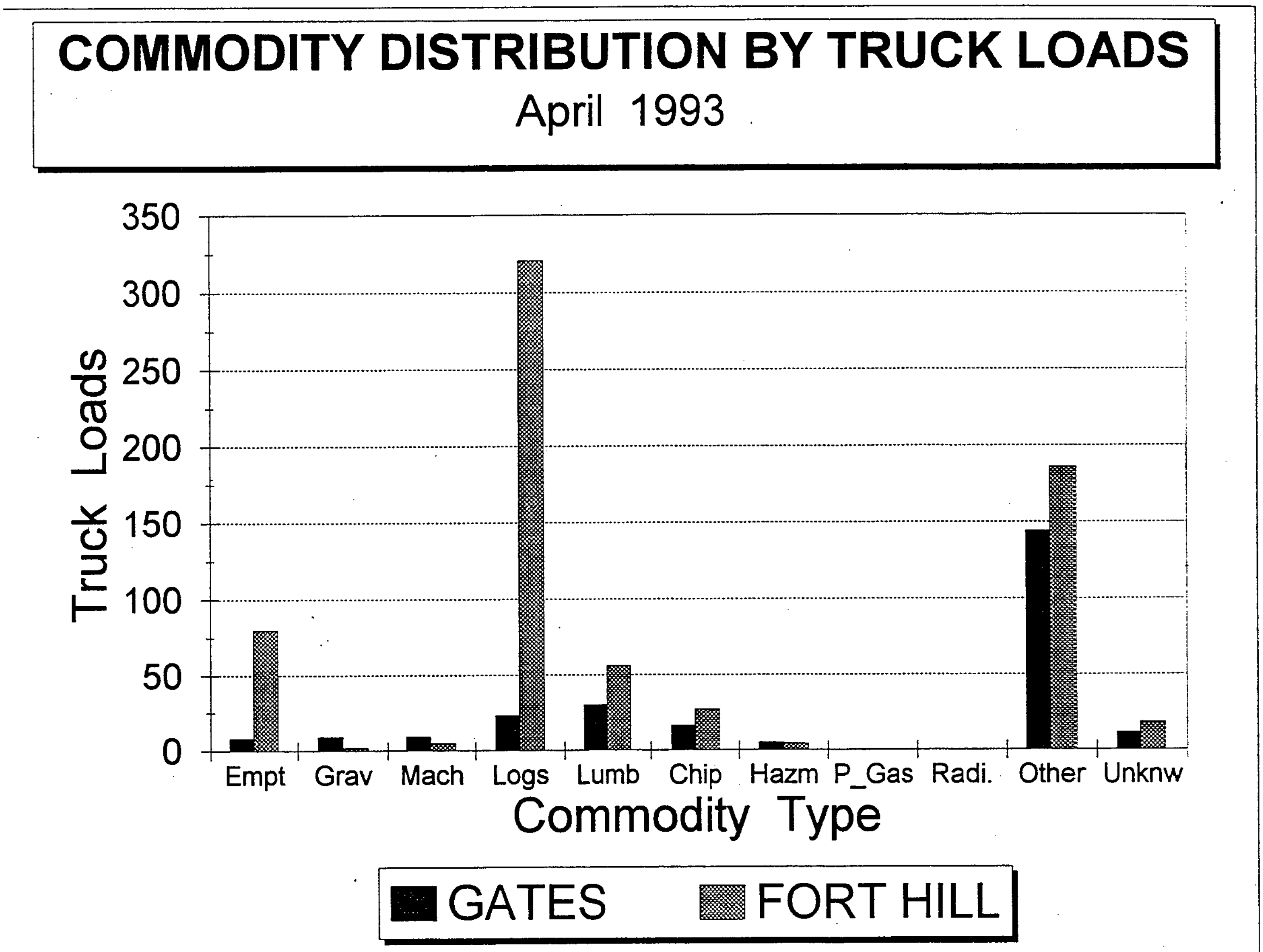
STATISTICAL REPORT

Commodity Distribution
(Percentage)

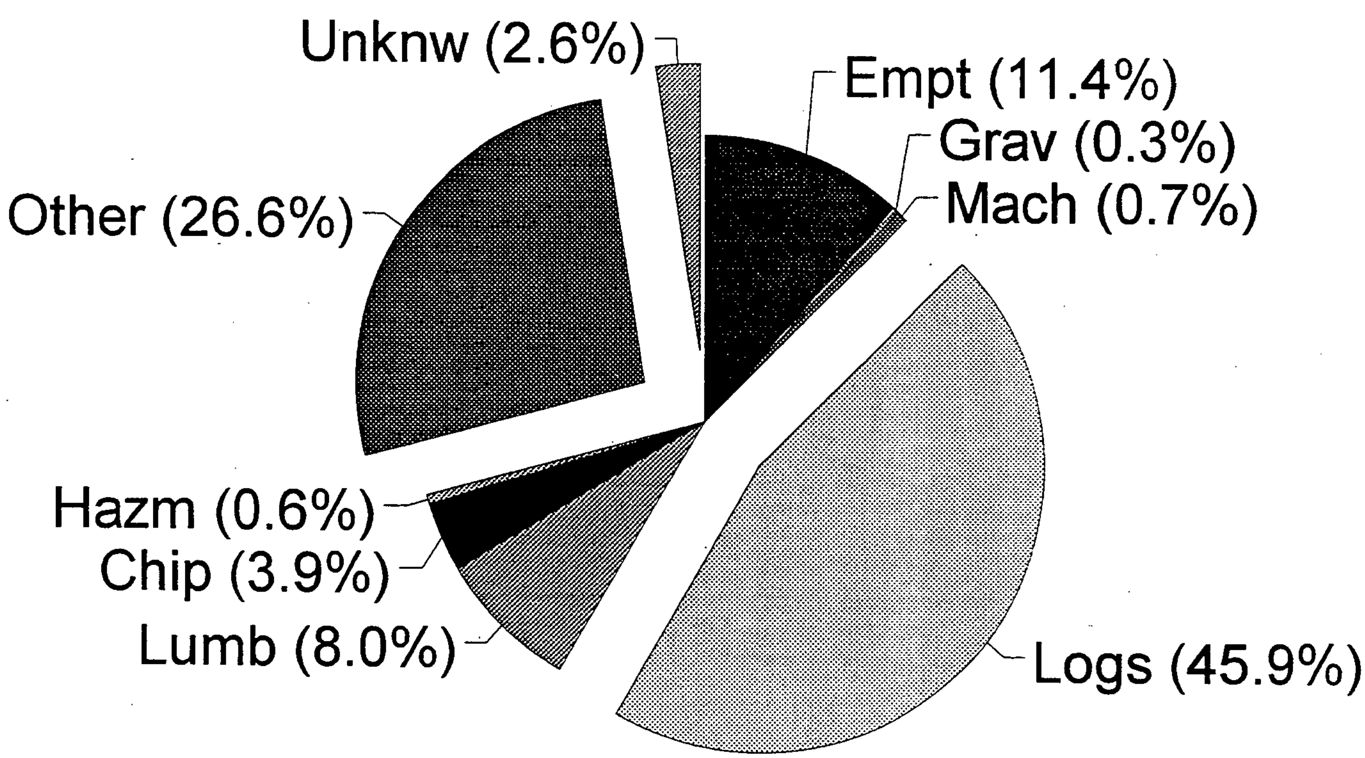
from: 04-01-93 to: 04-30-93

Report run date: May 14, 1994

Weight Station				Wood Products			Dangerous Materials				
	Empt	Grav	Mach	Logs	Lumb	Chip	Hazm	P_Gas	Radi.	Other	Unkwn
GATES	3	4	4	9	12	6	2			56	4
FORT HILL	11		1	46	8	4	1			27	3

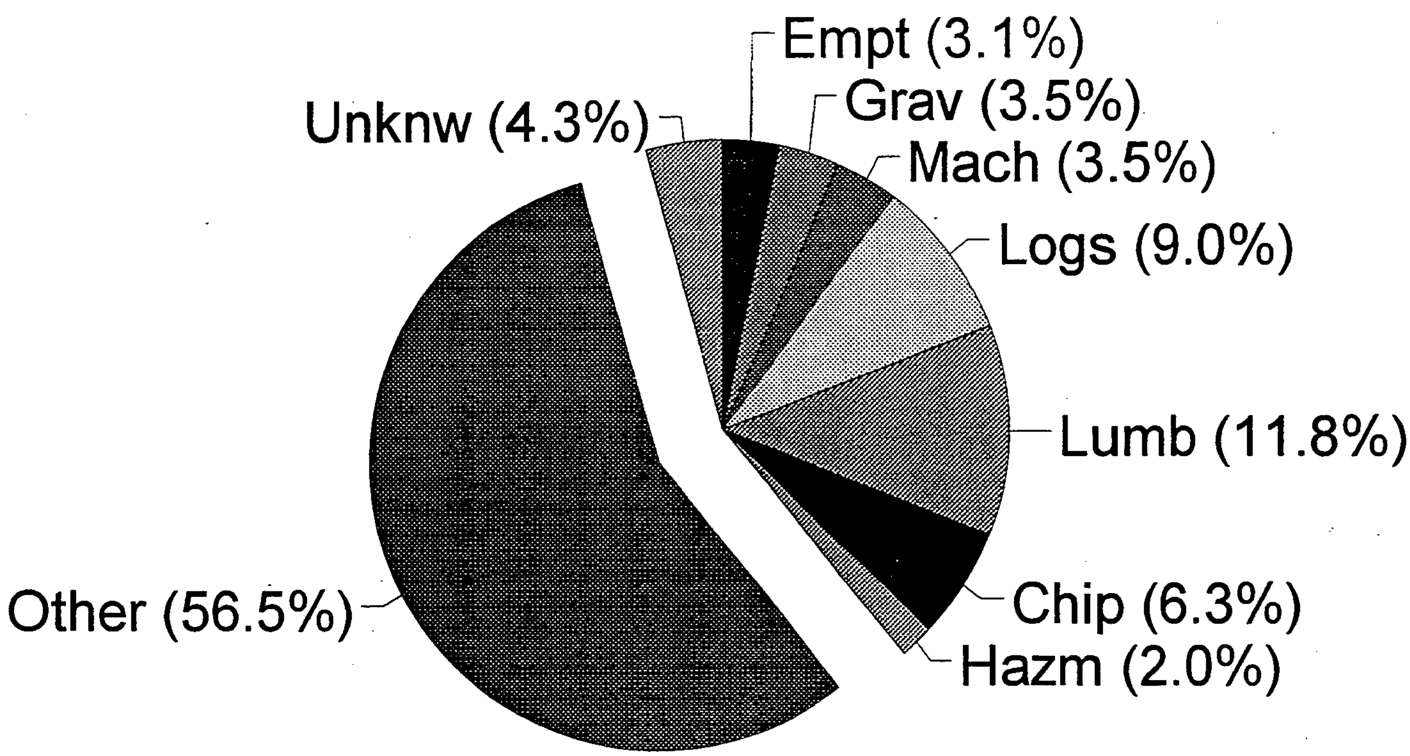

COMMODITY DISTRIBUTION BY TRUCK LOADS
April 1993
350
300
250
200
150
100
50
0
Truck Loads
Empt
Grav
Mach
Logs
Lumb
Chip
Hazm
P_Gas
Radi.
Other
Unknw
Commodity Type
GATES
FORT HILL

COMMODITY DISTRIBUTION BY TRUCK LOADS
FORT HILL (April 1993)



COMMODITY DISTRIBUTION BY TRUCK LOADS

GATES (April 1993)



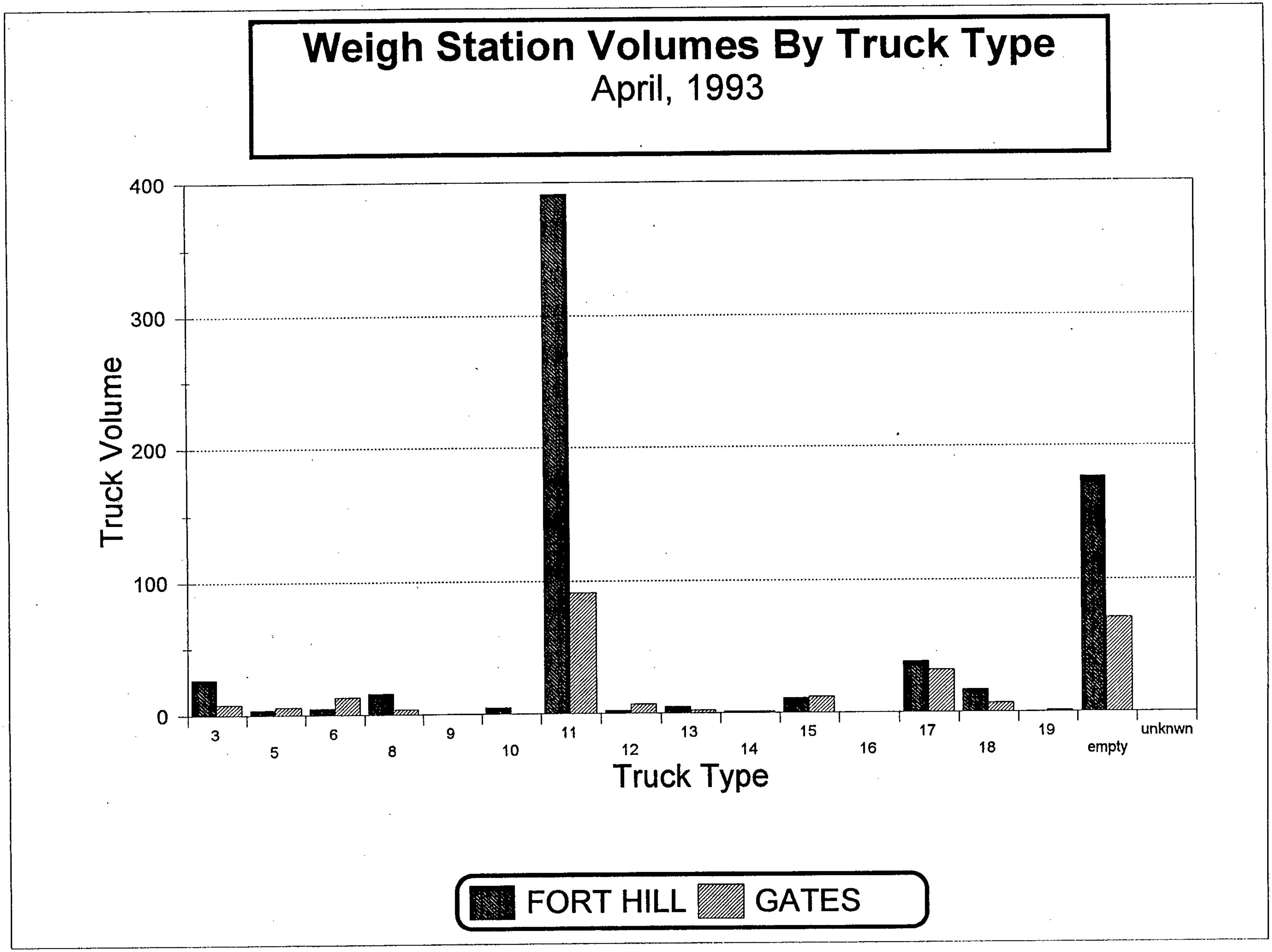
STATISTICAL REPORT

====================================
Truck Type Distribution

from: 03-01-93 to: 03-31-93
====================================

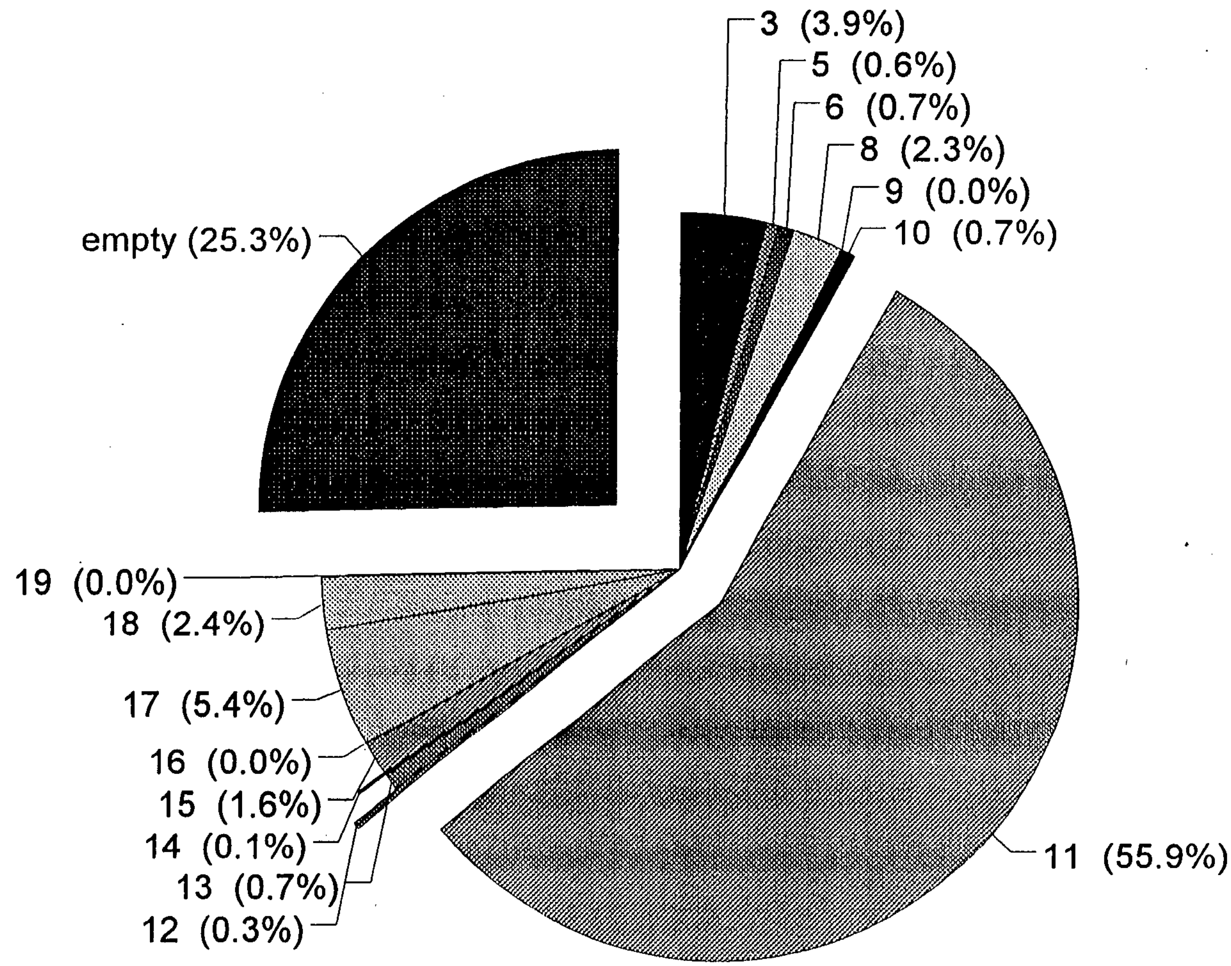
Report run date: May 14, 1994

Weight Station	Truck Type 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	empty	unknwn
FORT HILL			17		5	5		8			249		3		17		32	15		110	1
GATES			9			2		1		1	74	6	4		14		44	9		45	



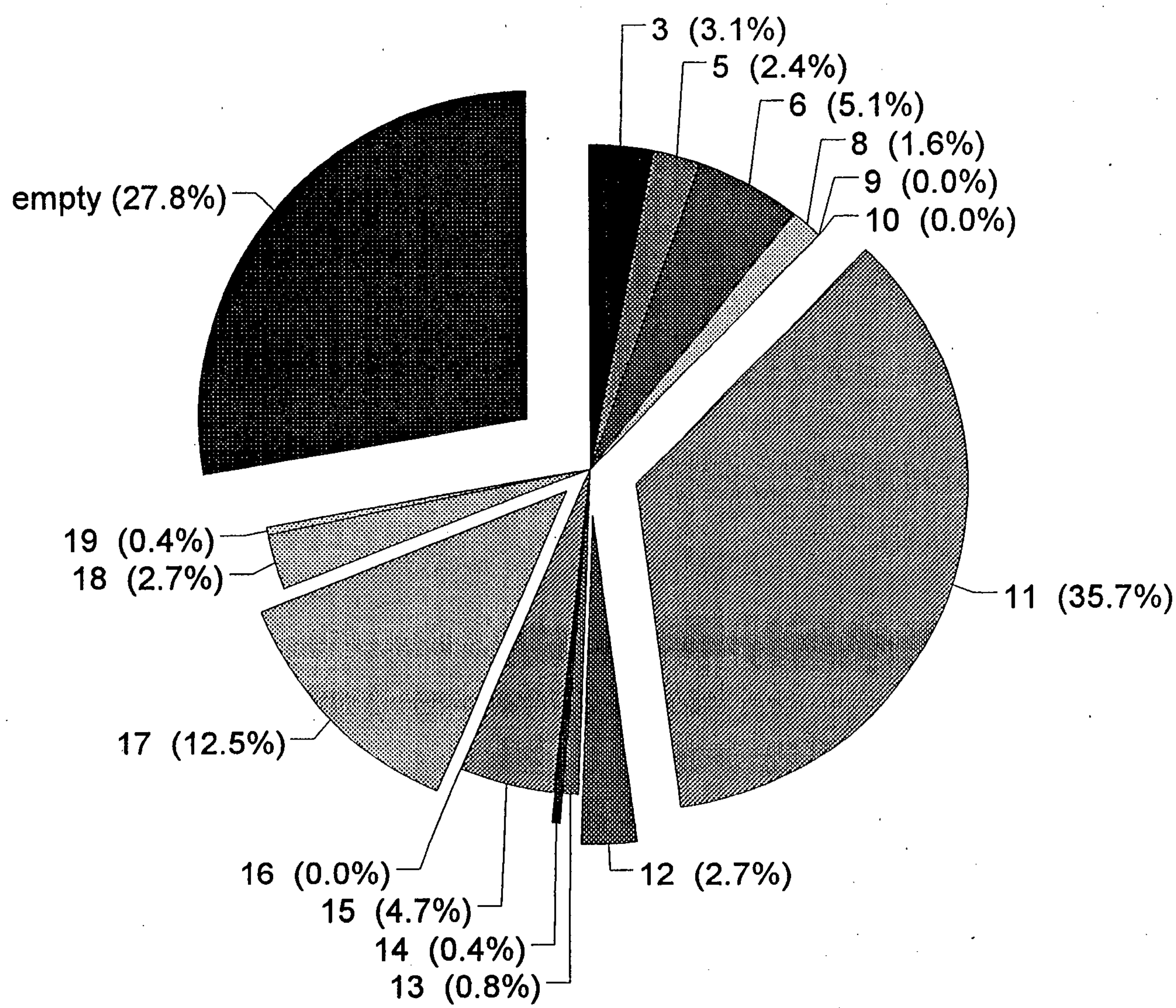
Weigh Station Volumes By Truck Type
April, 1993
Truck Volume
400
300
200
100
0
3
5
6
8
9
10
11
12
13
14
15
16
17
18
19
empty
unknwn
Truck Type
FORT HILL
GATES

Truck Distribution (%) By Truck Type
FORT HILL (04/93)



Truck Distribution (%) By Truck Type

GATES (04/93)



STATISTICAL REPORT

Hazardous Material Distribution
(Truck Loads)

from: 04-01-93 to: 04-30-93

Report run date: May 15, 1994

Weight Station	Blst	PGas	FlmS	Rad.	Oxyg	FlmG	Flmb	Cmbt	Oxid	Cors	PMat	OrgP	DngM	Othr	HazW	Emty	Mult
GATES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0
FORT HILL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1

APPENDIX D

Statistical Reports for Fort Hill and Gates Sites, April 1994

STATISTICAL REPORT

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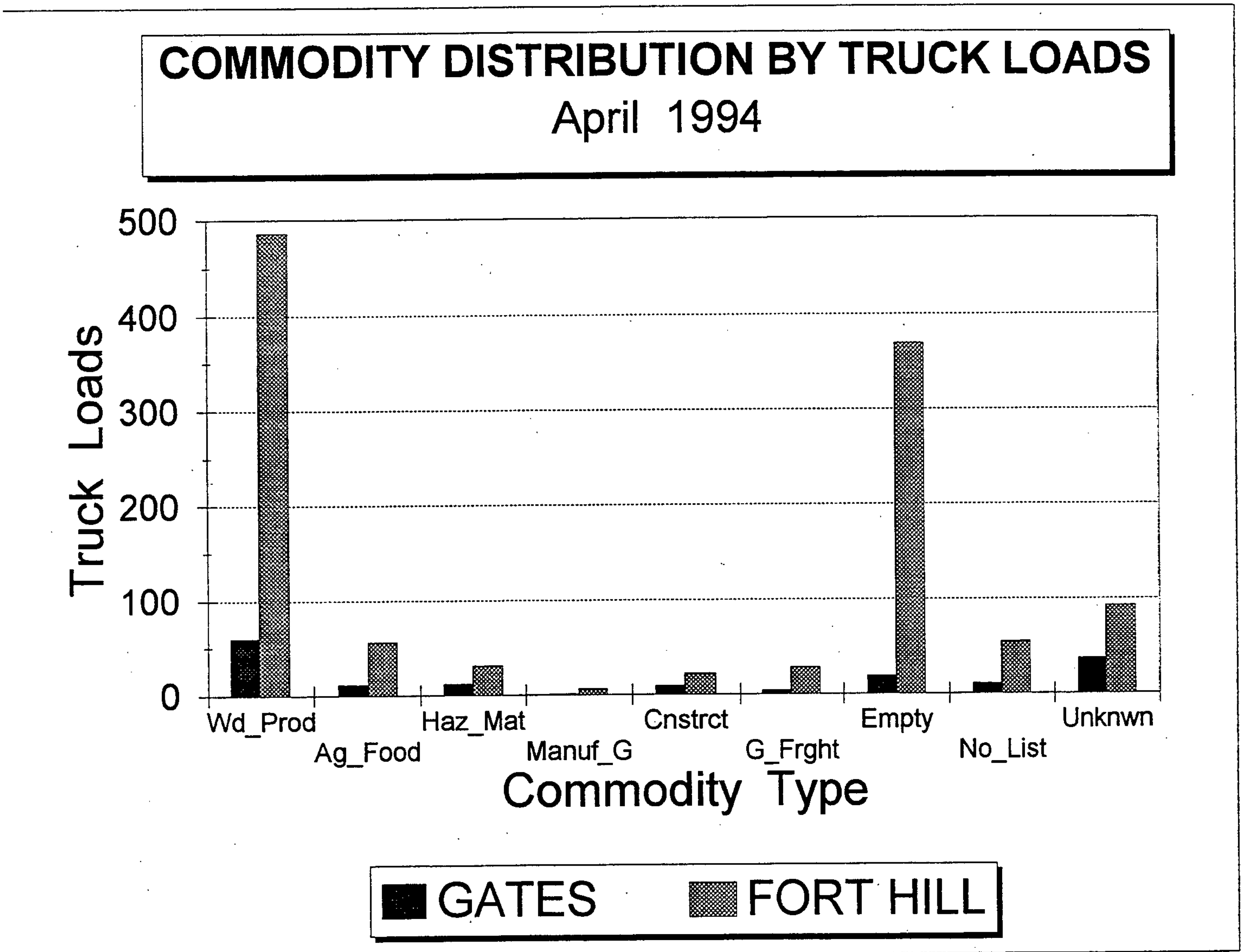
Commodity Distribution
(Truck Loads)

from: 04-01-94 to: 04-30-94
=====================================

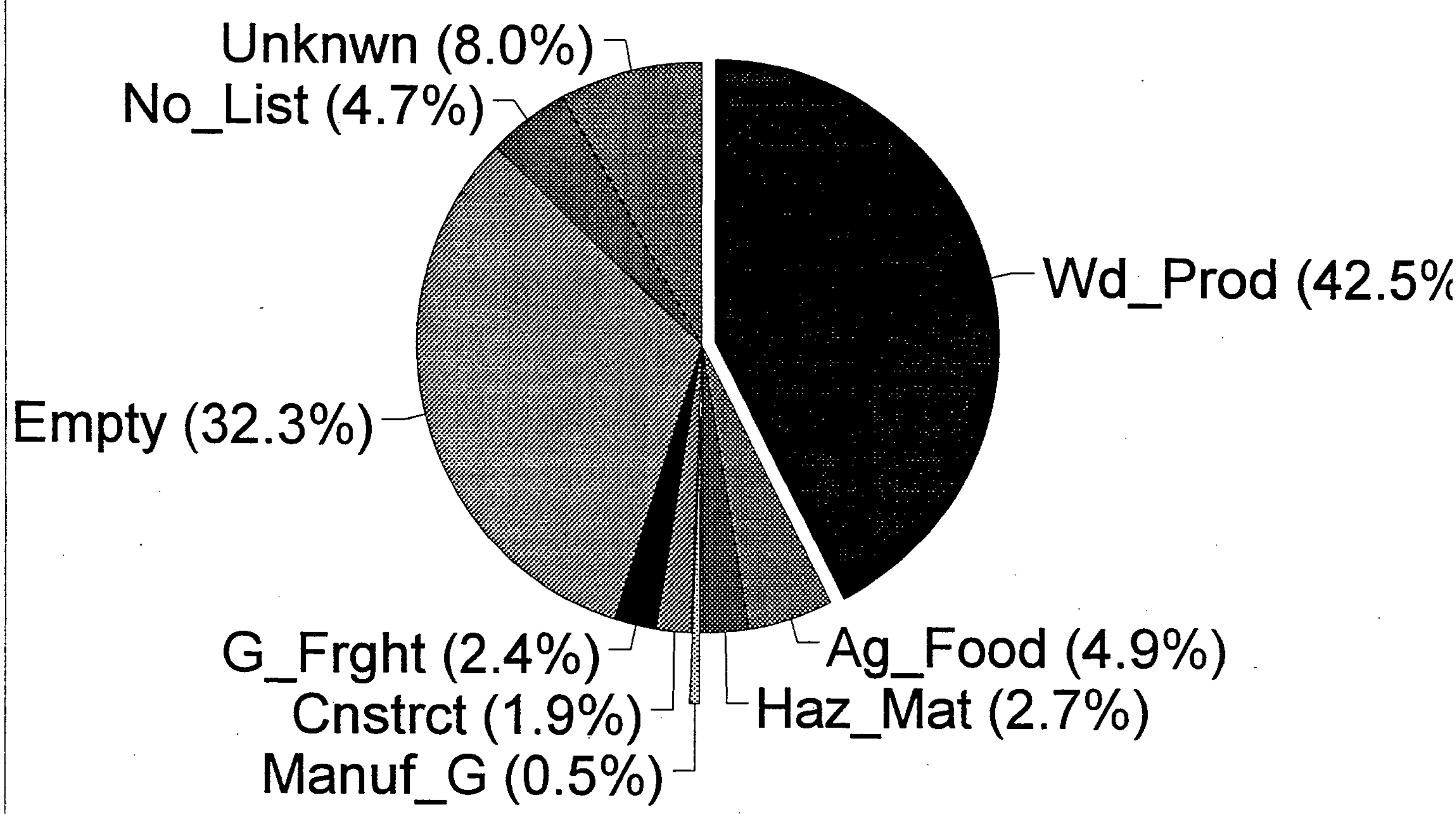
Report run date: Jun 01, 1994

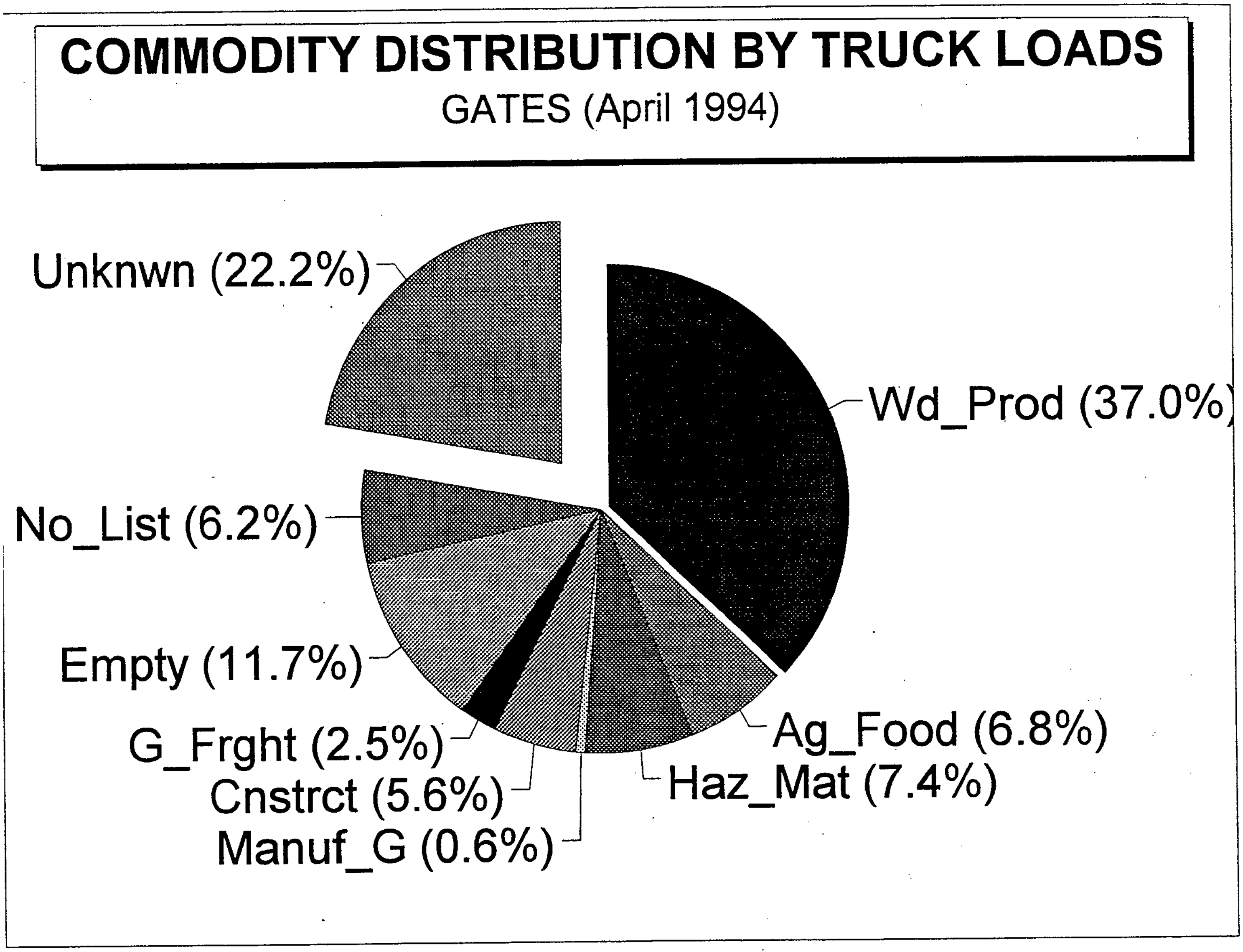
Sites	Wd_Prod	Ag_Food	Haz_Mat	Manuf_G	Cnstrct	G_Frght	Empty	No_List	Unknwn
GATES	60	11	12	1	9	4	19	10	36
FORT HILL	486	56	31	6	22	28	369	54	92


COMMODITY DISTRIBUTION BY TRUCK LOADS
April 1994
Truck Loads
500
400
300
200
100
0
Wd_Prod
Ag_Food
Haz_Mat
Manuf_G
Cnstrct
G_Frght
Empty
No_List
Unknwn
Commodity Type
GATES
FORT HILL

COMMODITY DISTRIBUTION BY TRUCK LOADS

FORT HILL (April 1994)




COMMODITY DISTRIBUTION BY TRUCK LOADS
GATES (April 1994)
Unknwn (22.2%)
Wd_Prod (37.0%)
No_List (6.2%)
Empty (11.7%)
G_Frght (2.5%)
Cnstrct (5.6%)
Manuf_G (0.6%)
Haz_Mat (7.4%)
Ag_Food (6.8%)

STATISTICAL REPORT

====================================

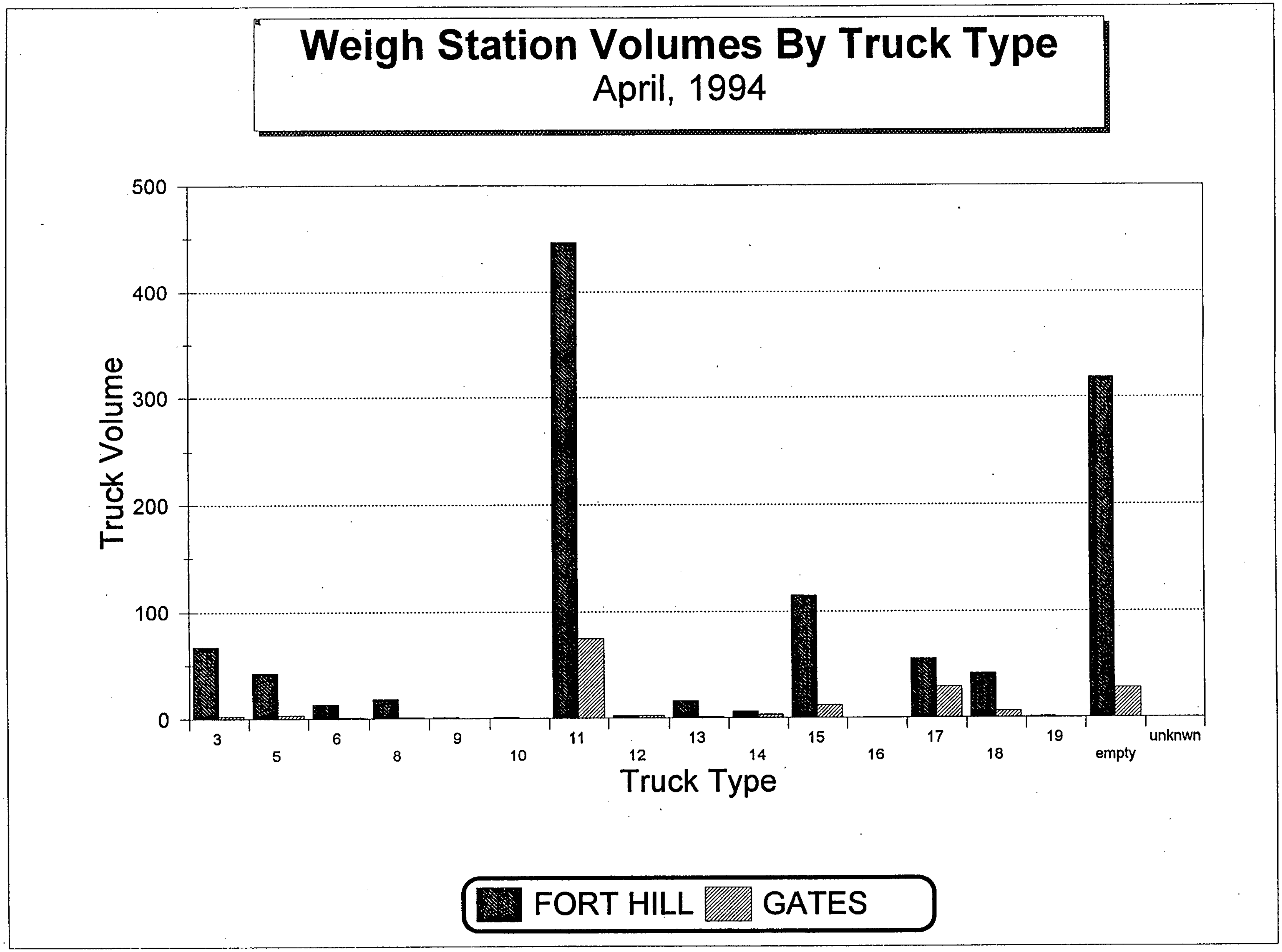
Truck Type Distribution

from: 04-01-94 to: 04-30-94

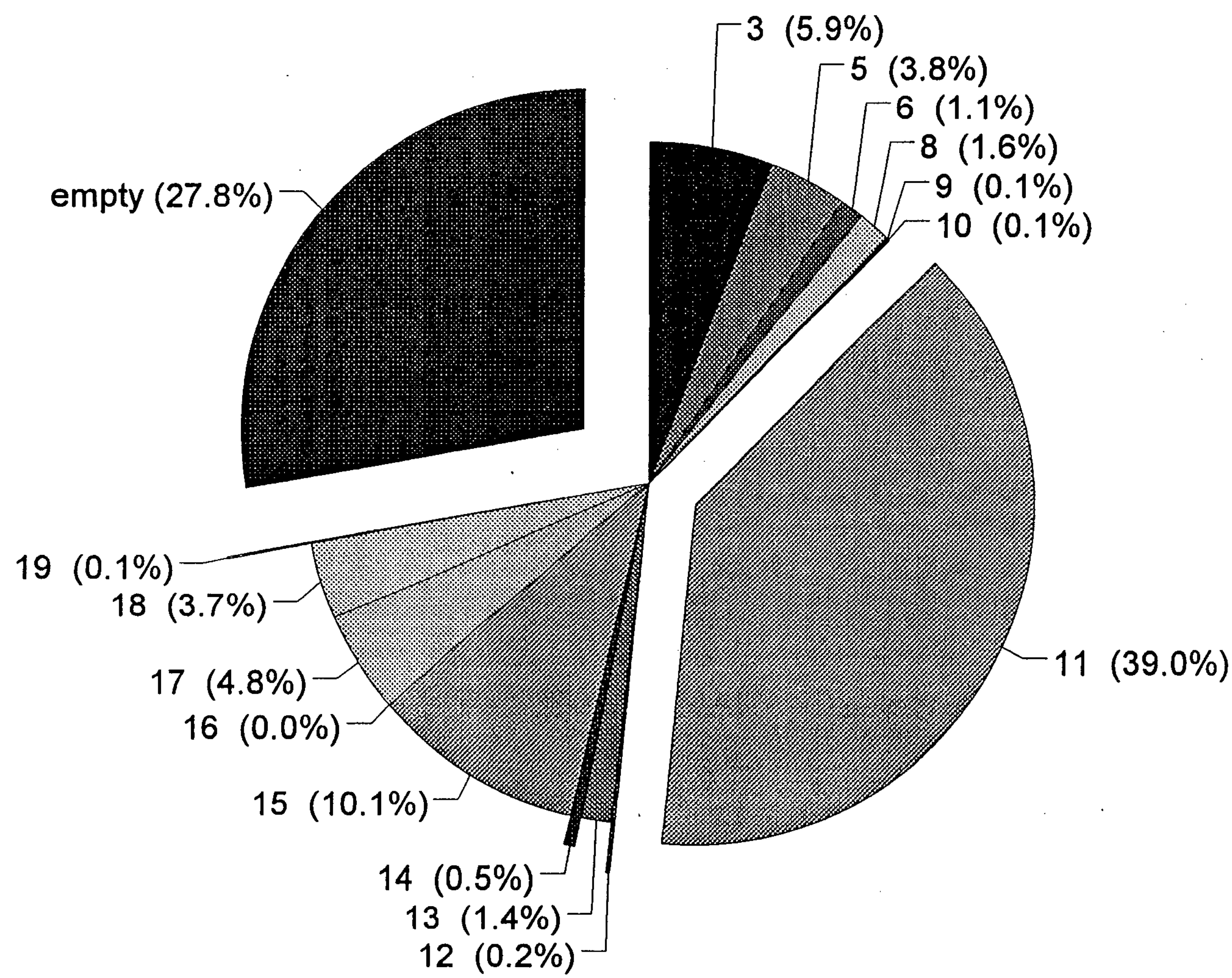
====================================

Report run date: Jun 01, 1994

	Truck Type																			
Weight Station	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	empty	unknwn
FORT HILL			67		43	13		18	1	1	446	2	16	6	115		55	42	1	318	
GATES			2		3	1		1			74	2	1	3	12		29	6		28	

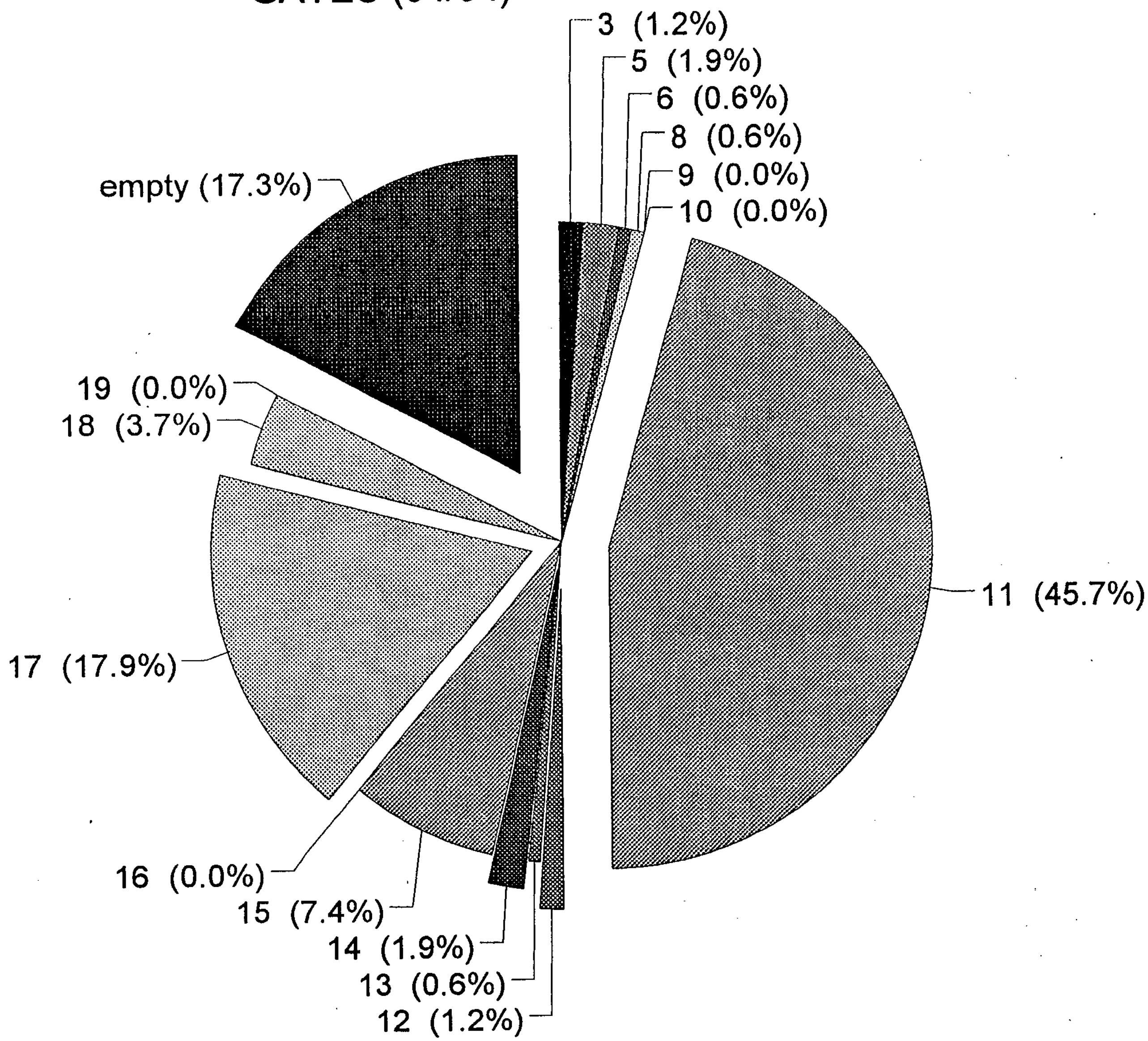

Weigh Station Volumes By Truck Type
April, 1994
Truck Volume
500
400
300
200
100
0
3
5
6
8
9
10
11
12
13
14
15
16
17
18
19
empty
unknwn
Truck Type
FORT HILL
GATES

Truck Distribution (%) By Truck Type
FORT HILL (04/94)



Truck Distribution (%) By Truck Type

GATES (04/94)



STATISTICAL REPORT

Hazardous Material Distribution
(Truck Loads)

from: 04-01-94 to: 04-30-94

Report run date: Jun 01, 1994

Weight Station	Blst	PGas	FlmS	Rad.	Oxyg	FlmG	Flmb	Cmbt	Oxid	Cors	PMat	OrgP	DngM	Othr	HazW	Emty	Mult
GATES	0	0	0	0	0	6	1	0	0	0	0	0	0	0	0	5	0
FORT HILL	0	0	0	3	0	25	1	0	0	1	1	0	0	0	0	0	0

STATISTICAL REPORT

=====================================
Commodity Distribution
(Truck Loads)

from: 04-01-94 to: 04-30-94
=====================================

Report run date: Jun 01, 1994

ID CODE	Weigh Site Casecade Lock	Asland	Fareburn POE	WoodBurn NB	WoodBurn POE	Gates	Fort Hill
0001						3	2
0002							21
0003						1	
0006							1
0009							3
0010						37	393
0012						8	61
0013						11	29
0019						1	
0020							5
0022						4	
0023							4
0024						2	4
0025						1	14
0026						2	17
0029						2	12
0041							1
0048						5	
0050							2
0053							2
0054						1	2
0060						4	14
0061						4	5
0064							2
0065						1	
0069							1
0070						2	9
0071						2	6
0072							13
0090						1	6
0095						36	92
0099						19	369

STATISTICAL REPORT

Commodity Distribution
(Truck Loads)

from: 04-01-94 to: 04-30-94

Report run date: Jun 01, 1994

ID CODE	Casecade Lock	Asland	Fareburn POE	WoodBurn NB	WoodBurn POE	Gates	Fort Hill
			Weigh Site				
1075							1
1203						6	25
1223						1	
2020							1
4020							3
4025						1	1
4026						1	5
4029						2	5
4069						1	
4070							9
4072							2
4090						1	
4099						1	1
6012						1	
9259							1

STATISTICAL REPORT

==================================

Commodity Distribution
(Percentage)

from: 04-01-94 to: 04-30-94

==================================

Report run date: Jun 01, 1994

tes	Wd_Prod	Ag_Food	Haz_Mat	Manuf_G	Cnstrct	G_Frght	Empty	No_List	Unknwn
TES	37	7	7	1	6	2	12	6	22
RT HILL	42	5	3	1	2	2	32	5	8

APPENDIX E

Statistical Reports for Five Rural Sites

for May 15, 1994, to June 16, 1994

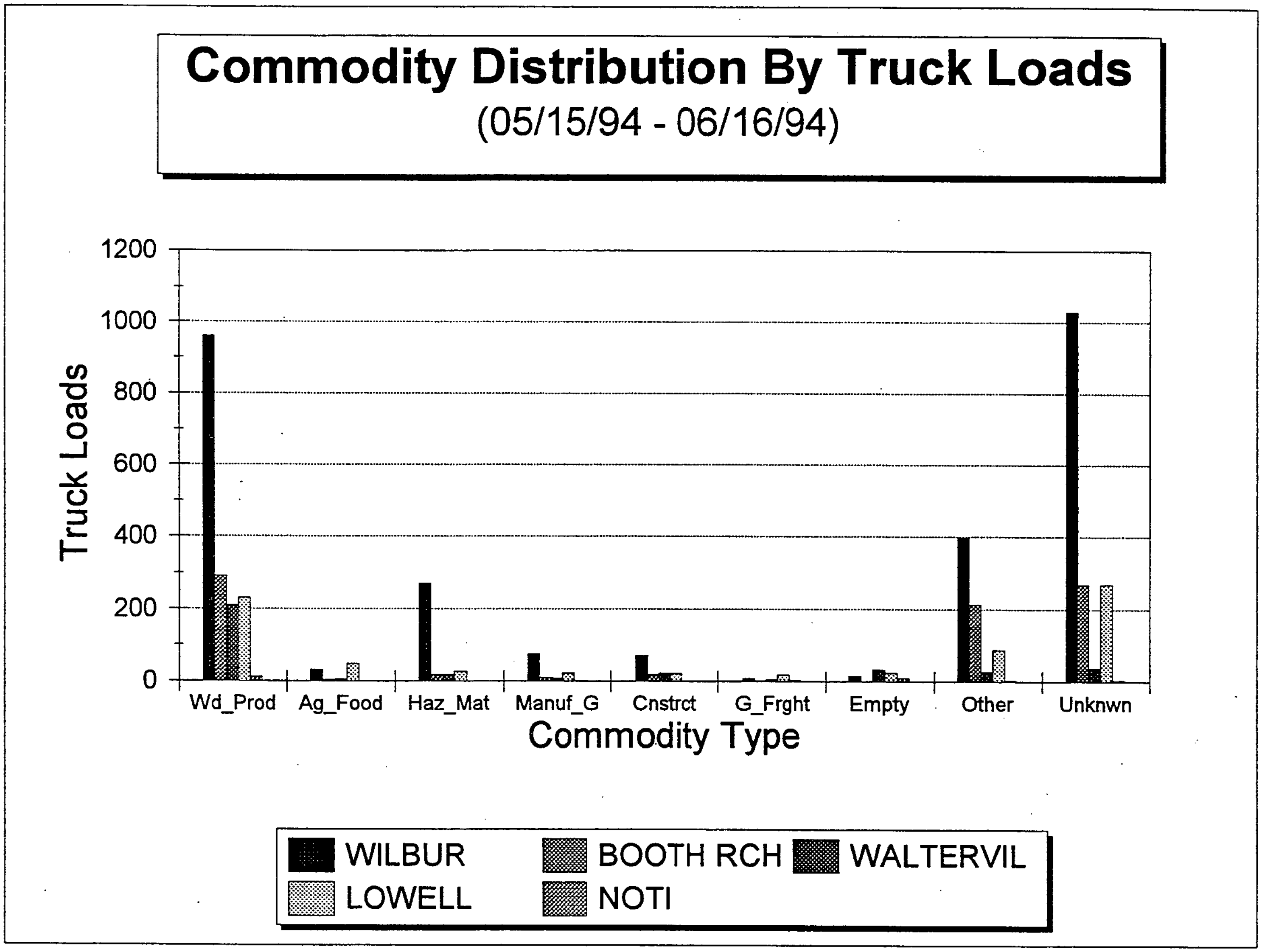
STATISTICAL REPORT

Commodity Distribution
(Truck Loads)

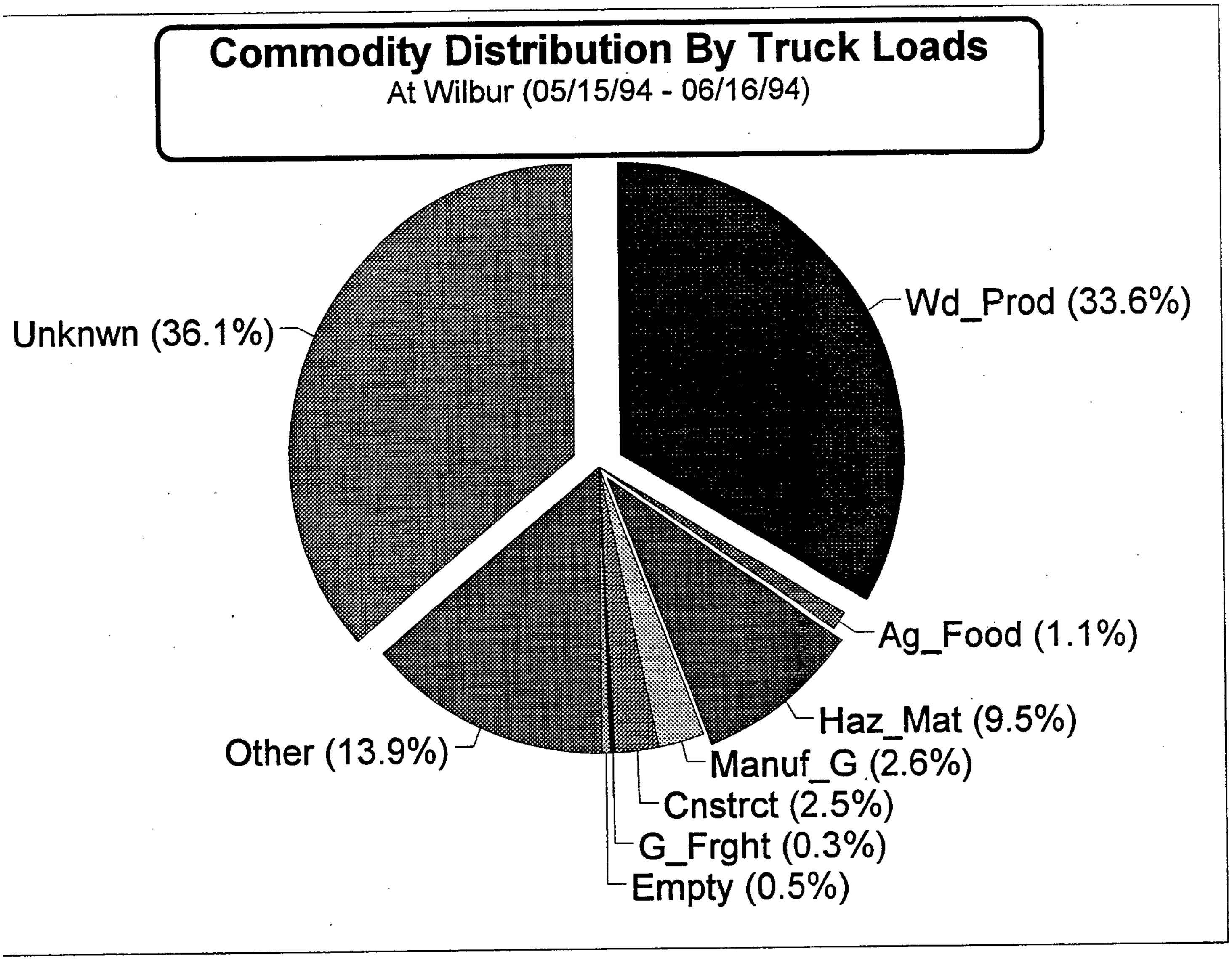
from: 05-15-94 to: 06-16-94

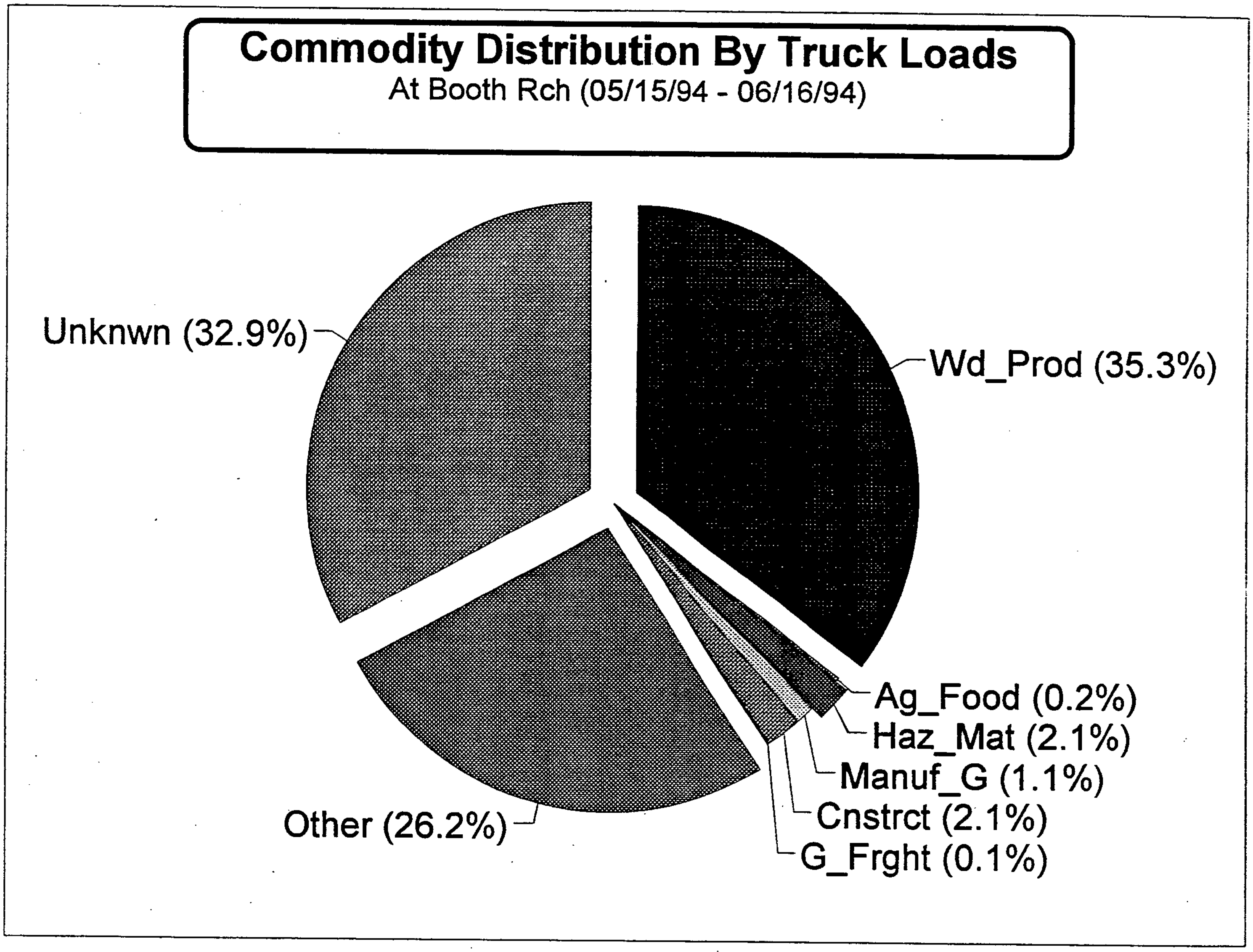
Report run date: Aug 01, 1994

ites	Wd_Prod	Ag_Food	Haz_Mat	Manuf_G	Cnstrct	G_Frght	Empty	Other	Unknwn
ILBUR	960	31	270	74	70	8	14	398	1030
OOTH RCH	289	2	17	9	17	1		214	269
ALTERVIL	210	4	18	8	22	4	33	27	37
OWELL	230	48	27	22	21	17	24	87	269
OTI	12			1		3	9	2	3

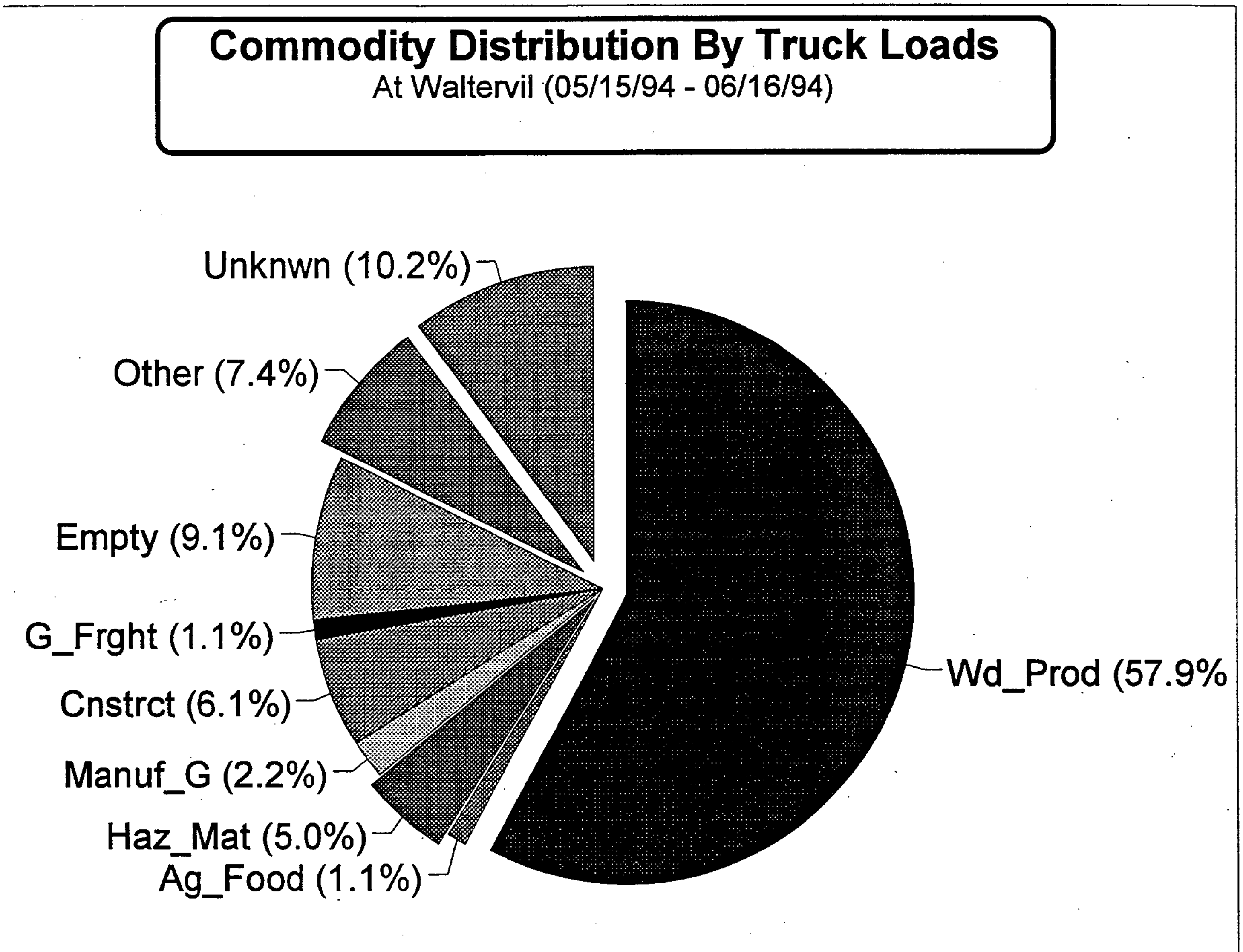


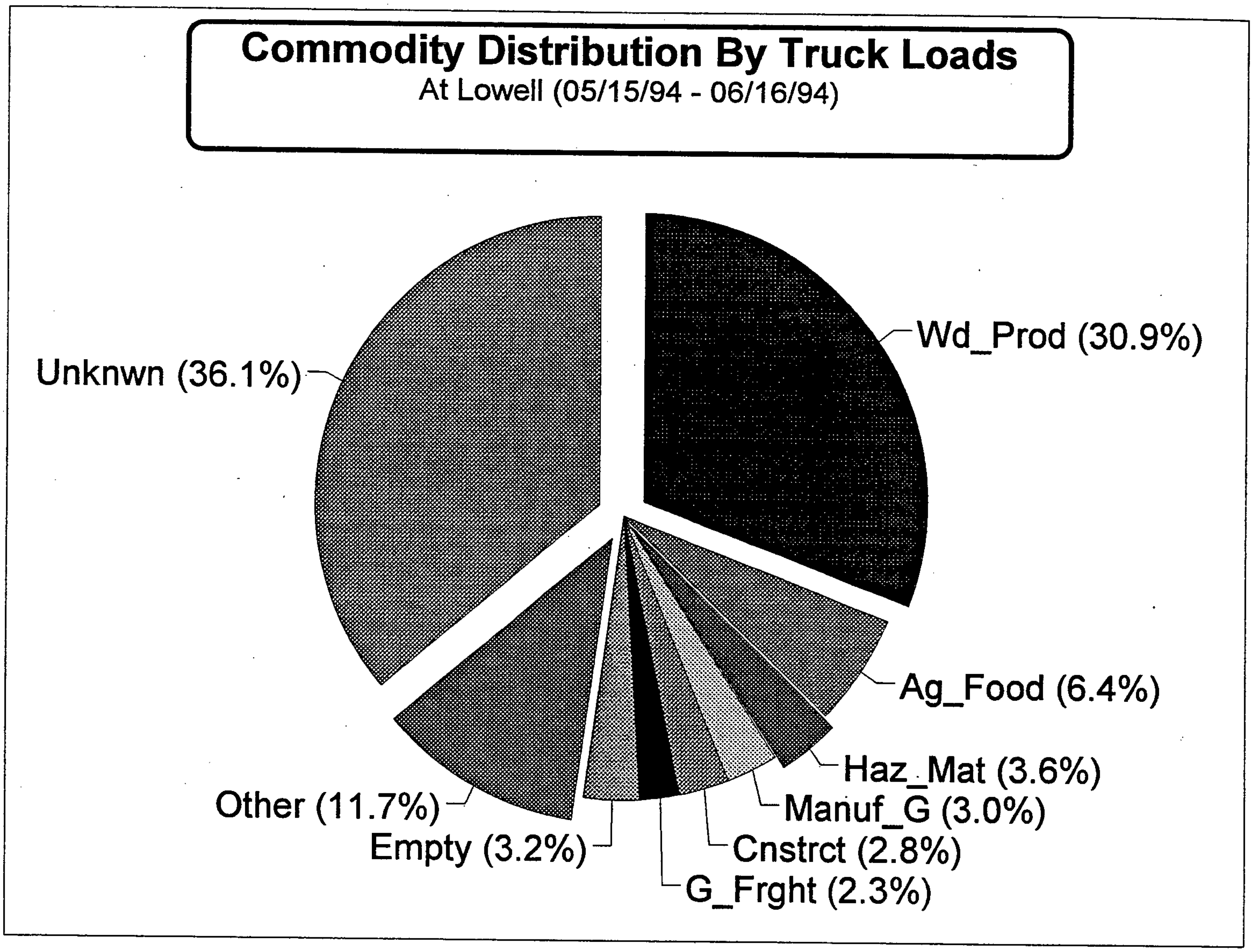
Commodity Distribution By Truck Loads
(05/15/94 - 06/16/94)
Truck Loads
1200
1000
800
600
400
200
0
Wd_Prod
Ag_Food
Haz_Mat
Manuf_G
Cnstrct
G_Frght
Empty
Other
Unknwn
Commodity Type
WILBUR
BOOTH RCH
WALTERVIL
LOWELL
NOTI


Commodity Distribution By Truck Loads
At Wilbur (05/15/94 - 06/16/94)
Wd_Prod (33.6%)
Unknwn (36.1%)
Ag_Food (1.1%)
Haz_Mat (9.5%)
Other (13.9%)
Manuf_G (2.6%)
Cnstrct (2.5%)
G_Frght (0.3%)
Empty (0.5%)


Commodity Distribution By Truck Loads
At Booth Rch (05/15/94 - 06/16/94)
Unknwn (32.9%)
Wd_Prod (35.3%)
Ag_Food (0.2%)
Haz_Mat (2.1%)
Manuf_G (1.1%)
Cnstrct (2.1%)
G_Frght (0.1%)
Other (26.2%)

E 4

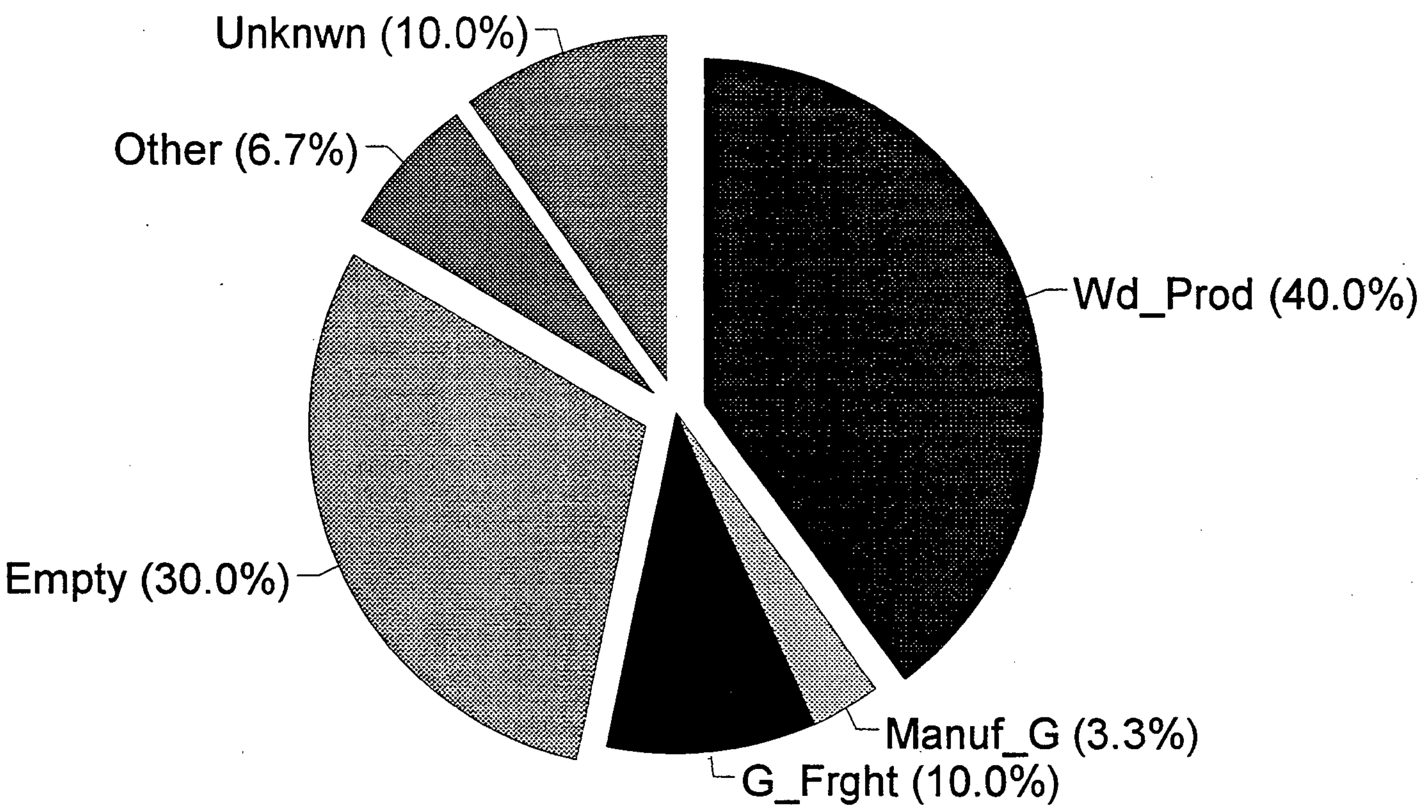

Commodity Distribution By Truck Loads
At Waltervil (05/15/94 - 06/16/94)
Unknwn (10.2%)
Other (7.4%)
Empty (9.1%)
G_Frght (1.1%)
Cnstrct (6.1%)
Manuf_G (2.2%)
Haz_Mat (5.0%)
Ag_Food (1.1%)
Wd_Prod (57.9%



Commodity Distribution By Truck Loads
At Lowell (05/15/94 - 06/16/94)
Unknwn (36.1%)
Wd_Prod (30.9%)
Ag_Food (6.4%)
Haz_Mat (3.6%)
Manuf_G (3.0%)
Cnstrct (2.8%)
G_Frght (2.3%)
Empty (3.2%)
Other (11.7%)

Commodity Distribution By Truck Loads

At Noti (05/15/94 - 06/16/94)



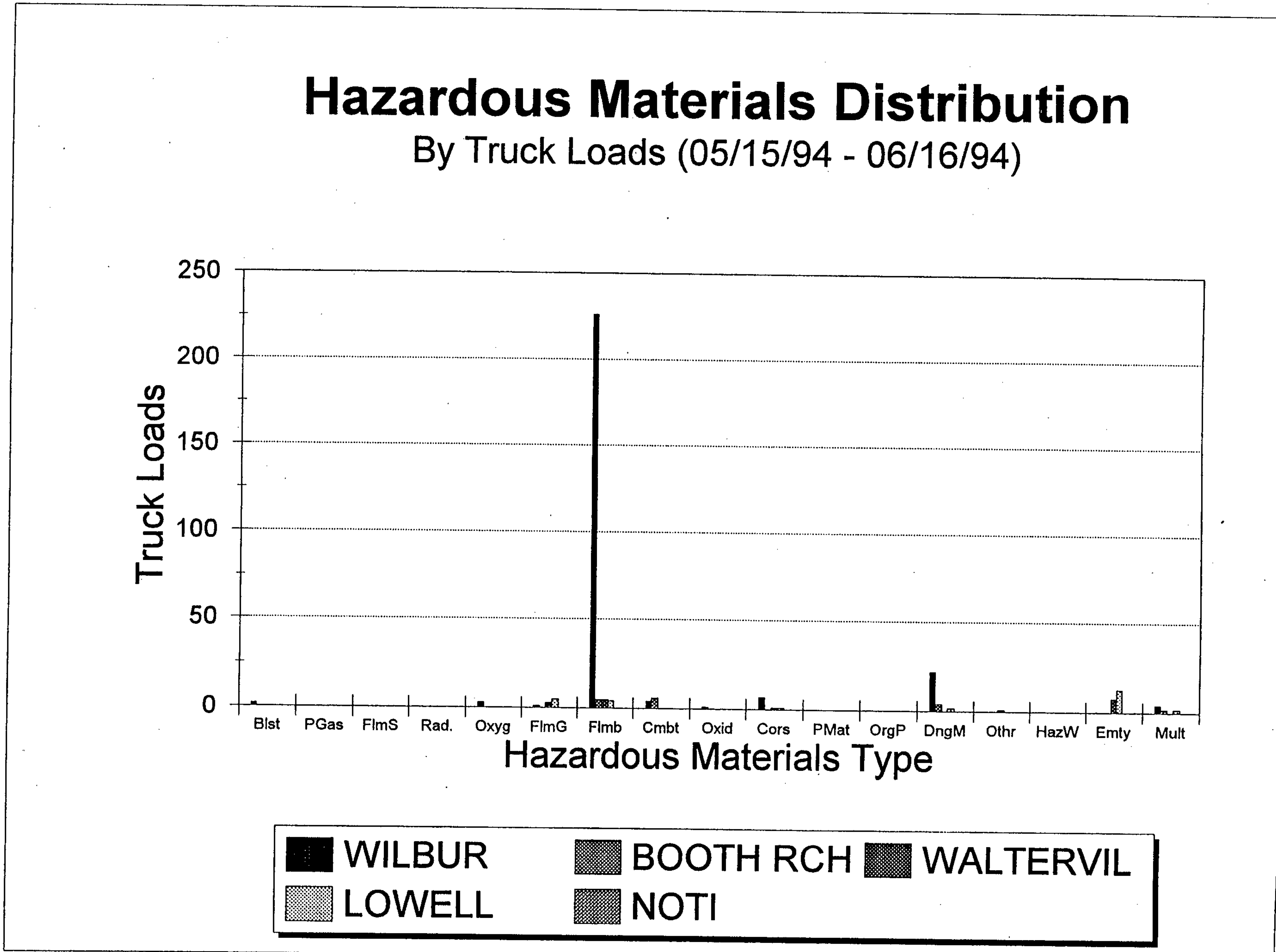
STATISTICAL REPORT

Hazardous Material Distribution
(Truck Loads)

from: 05-15-94 to: 06-16-94

Report run date: Jul 31, 1994

Site	Blst	PGas	FlmS	Rad.	Oxyg	FlmG	Flmb	Cmbt	Oxid	Cors	PMat	OrgP	DngM	Othr	HazW	Emty	Mult
WILBUR	2	0	0	0	3	1	226	4	1	7	0	0	22	0	0	0	4
BOOTH RCH	0	0	0	0	0	0	5	6	0	0	0	0	4	0	0	0	2
WALTERVIL	0	0	0	0	0	3	5	0	0	1	0	0	0	1	0	8	0
LOWELL	0	0	0	0	0	5	4	0	0	1	0	0	2	0	0	13	2
NOTI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0


Hazardous Materials Distribution
By Truck Loads (05/15/94 - 06/16/94)
Truck Loads
250
200
150
100
50
0
Blst
PGas
FlmS
Rad.
Oxyg
FlmG
Flmb
Cmbt
Oxid
Cors
PMat
OrgP
DngM
Othr
HazW
Emty
Mult
Hazardous Materials Type
WILBUR
BOOTH RCH
WALTERVIL
LOWELL
NOTI

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